3. Initial Evaluation

Number

3. INITIAL EVALUATION

The potential sources of groundwater contamination at Test Area North (TAN) and the existing information characterizing these sources was presented in Sections 2.3 and 2.4. Section 3 describes the remedial investigation/ feasibility study (RI/FS) process and its implementation for the TAN Groundwater Operable Unit, and also presents the conceptual model developed on the basis of available data.

3.1 RI/FS Process

The purpose of the remedial process is to assess and define site conditions, and to evaluate and develop alternatives to the extent necessary to select a remedy through a Record of Decision. Generally, the RI/FS is the first major step in the process. The RI and FS are fully integrated and are concurrent activities to the extent practicable.

The purpose of the RI is to collect data necessary to adequately characterize the site to support the remedy selection decision. During the RI, the Department of Energy (DOE) shall conduct field investigations and a baseline risk assessment. Site characterization may be performed in one or more phases to focus sampling efforts and to efficiently use available resources.

The principal objective of the feasibility study is to ensure appropriate remedial alternatives are developed and evaluated so that relevant information concerning remedial options can be presented to the decision maker and an appropriate remedy can be selected. During the FS, alternatives shall be developed that protect human health and the environment by eliminating, reducing, and/or controlling risks. The actual number and type of alternatives to be analyzed is a site-specific decision. The National Contingency Plan (EPA, 1990) imposes some action-specific considerations on the development and screening process, and the short- and long-term aspects of effectiveness, implementability, and cost generally guide the initial screening process. Detailed analyses are conducted on a limited number of alternatives that pass the screening process and represent viable remedial approaches. The detailed analysis consists of assessing individual alternatives against each of nine evaluation criteria and comparing the relative performance of each alternative against those criteria.

The nine criteria are the following:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements (ARARs)
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, and volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance.

The preferred remedial alternative resulting from the FS process is presented for public review in the Proposed Plan. After public input, the remedy is selected and documented through the Record of Decision process.

3.2 RI/FS Implementation for the TAN Groundwater System

3.2.1 RI/FS Objectives

In general, this RI/FS is intended to:

- Determine the concentration and distribution of contaminants in the groundwater at TAN. The nature of the groundwater contaminants is fairly well known and includes trichloroethylene (TCE) and related volatile organics, as well as strontium-90, tritium, and lead as the major contaminants of concern
- Determine if human or environmental receptors are at risk (or potentially at risk) from exposure to site contaminants or to contaminants transported from the site
- Determine and evaluate feasible remedial alternatives

3.2.2 Preliminary Site Model

Based on an evaluation of existing information, a preliminary site model has been developed to focus RI activities on providing information that aids the specific accomplishment of RI/FS objectives.

The site conceptual model is a hypothetical description of the sources, pathways, and receptors of contaminants at a hazardous waste site. The task of an RI is to remove uncertainty regarding the hypothetical nature of the model. Once the sources, pathways, and receptors of hazardous contaminants at a site are quantitatively described, a baseline risk assessment can be performed, and the process of selecting remedial actions can begin.

The definition of the groundwater operable unit is based on the Federal Facility Agreement/Consent Order and Action Plan between the DOE, the EPA, and the State of Idaho. The preliminary identification of the specific sources and receptors for the TAN Groundwater RI/FS presented in the conceptual model was based on the following rationale:

- The Idaho National Engineering Laboratory (INEL) was listed as a National Priorities List site due, in part, to the release of TCE to the Snake River Plain Aquifer from source(s) at TAN (EPA, Federal Facilities Docket).
- The primary source of these known releases at TAN has been identified as the Technical Support Facility (TSF)-05 injection well. Other potential but unconfirmed and probably minor contaminant sources may include the Initial Engine Test Facility (IET) injection well and the Water Reactor Research Test Facility (WRRTF) injection well (EG&G Idaho, 1988, 1991b).

The conceptual model of the TAN release site includes the potential source units, release mechanisms, pathways of release, and receptors. It should be noted that while TCE is identified as the primary contaminant of concern, it is not the only contaminant of concern. Specifically, tetrachloroethylene, 1,1 dichloroethylene, lead, mercury, tritium, and strontium-90 have also been detected at elevated concentrations in the groundwater system, although their distribution is not as widespread as TCE. A graphical representation of this model is shown in Figure 3-1.

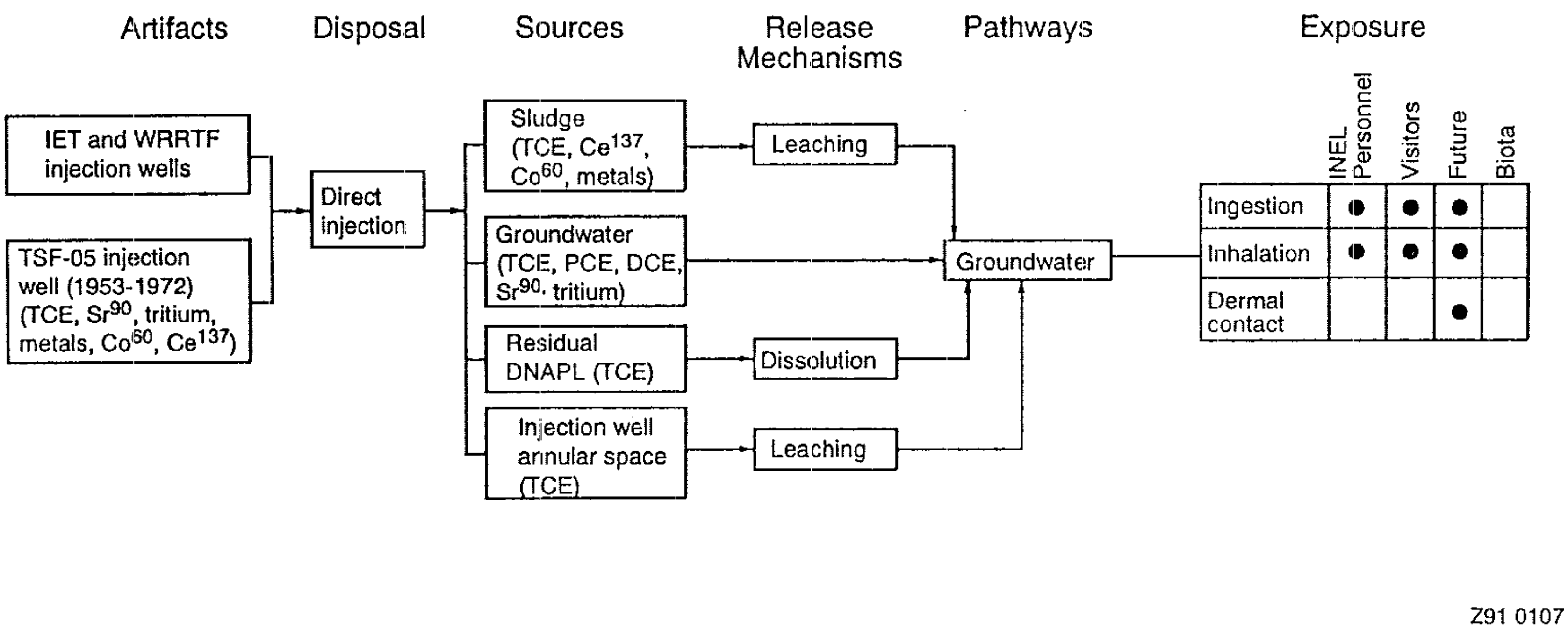


Figure 3-1. Conceptual model of TAN release site showing contaminant sources, release mechanisms, pathway, and potential exposure routes.

The following discussion summarizes information known about model compartments and the factors identified above that affect contaminant movement among model compartments. This discussion summarizes information presented in Section 2 of this Work Plan. Hypotheses are presented in the following discussion that will be verified or negated by data developed during proposed remedial investigation and interim action activities.

3.2.2.1 Movement of Water and Contaminants. Waste water and sludges disposed in the injection wells were discharged directly to the Snake River Plain Aquifer through direct injection. In addition to direct injection, available data indicate that there is a potential for contaminated sediment/sludge in the annular space of the TSF-05 injection well; therefore, leaching of contaminants to the groundwater is also possible. Furthermore, at the TCE concentrations detected in the TSF-05 sediment/sludge (~2%), the potential exists for residual dense, nonaqueous phase liquids (DNAPL) being present, from which dissolution or leaching of TCE to the groundwater system may be occurring. As contaminants from either general source (sludge or direct injection to the groundwater) enter the groundwater system, the contaminants move down-gradient and are dispersed, and the concentrations decrease.

The RI will attempt to determine the vertical extent of groundwater contamination, the southern lateral extent of contamination and, along with information obtained during the interim action on the TSF-05 injection well (see the Interim Action addendum), will attempt to verify the hypothesis that the injection well is the primary source of contamination. The potential for the IET and WRRTF injection wells being contaminant sources will be evaluated through RI groundwater sampling and monitoring. Groundwater sampling activities, as well as monitor well installation and testing, will help to better define site characteristics and aid in the development of remedial action alternatives.

3.2.2.2 RI/FS Scope. Three potential sources of trichlorethylene, metals, and radionuclides have been identified. These sources are the TSF-05 injection well, the IET injection well (IET-06), and the WRRTF injection well (WRRTF-05). Two other potential sources (the TSF-07 disposal pond and the TSF-11 clarifier pits) were sampled during RFI activities and, based on the analyzed data, are not groundwater contamination sources. Two of the sites listed above (the IET and WRRTF injection wells) are also considered to be only minor groundwater contaminant sources, if they are sources at all. Groundwater contaminants near the IET and WRRTF injection wells are at concentrations at or below drinking water standards. In contrast, the TSF-05 injection well has released organics, metals, and radionuclides into the groundwater. While trichloroethylene has been identified as the major contaminant of concern and is the most widely distributed contaminant in the groundwater system, tetrachloroethylene, 1,1 dichloroethylene, lead, mercury, and strontium-90 have also been detected at concentrations above drinking water standards near the injection well.

The RI/FS activities proposed in this Work Plan will identify and investigate all potential contaminants and injection well sources. The TSF-05 injection well will be evaluated through an interim action, which will be conducted concurrently with the RI/FS (see the Interim Action addendum). The IET and WRRTF injection wells will be evaluated by additional groundwater sampling. The perched water found under the TSF-07 pond (or any new perched water zones) will not be evaluated under this RI/FS. Water was the primary transport mechanism from TAN contamination areas. The water transported contaminants directly to the exposure pathway (regional groundwater aquifer). The risk to human populations and the environment will depend on the exposure pathway and scenario.

The conceptual model shown in Figure 3-1, the scoping meetings held with the DOE, the EPA, and the Idaho Department of Health and Welfare representatives, and the approved RI/FS Scope of Work provided the basis for identifying data gaps and the proposed RI tasks. For example, existing information provides data on contaminant concentrations in the TSF-05 injection well and groundwater, and the approximate northern, eastern, and western lateral extent of contamination in the shallow part of the aquifer, but data are not available on the southern lateral extent of contamination, the vertical contaminant concentrations or distribution, or the possibility of DNAPL being present in the subsurface adjacent to the injection well. Work plan rationale for investigation activities to fill these data gaps are presented in Section 4 and in the Interim Action addendum.

3.2.3 RI Phasing at the TAN Groundwater Operable Unit

With available data, it has been possible to develop an initial site model; furthermore, it has been assumed that all the data collection needs necessary to achieve RI/FS objectives have been identified. Remedial investigation activities are described in this Work Plan and will focus primarily on characterizing the vertical extent of contamination, the southern lateral extent of contamination, and potential contaminant movement/distribution effects resulting from subsurface hydrogeological conditions. Following the completion of RI activities, an RI report will be prepared that (a) summarizes existing and new data, (b) draws conclusions based on these data, and (c) presents the results of the baseline risk assessment, and fate and transport modeling.

Specific data collection with regard to nonhuman biological receptors is not planned for the TAN groundwater RI. Available INEL information will be used.

Specific schedules for remedial response for the TAN groundwater system are outlined in Section 6.

4. Work Plan Rationale

Number

4. WORK PLAN RATIONALE

This section presents an evaluation and identification of the data needs required for completing the remedial investigation for the Test Area North (TAN) Groundwater Operable Unit 1-07B. As part of the process of determining data needs, available information must be evaluated with respect to the types of decisions requiring answers. Data gaps can then be identified and data quality objectives can be defined as described below.

Data quality objectives (DQOs) are qualitative and quantitative statements that are specified to ensure that data of known and appropriate quality are obtained during the remedial response process. DQOs are developed for each data collection activity in the remedial response process (remedial investigation, feasibility study, remedial design, and remedial action).

For the efficient use of resources, a remedial investigation is best approached as an iterative process. A conceptual model is developed, and data are gathered to validate the model. Frequently, subsequent phases are necessary to fill data gaps. This remedial investigation/feasibility study (RI/FS) represents the second phase in the process. Existing data will be evaluated to assess any remaining gaps that must be addressed in subsequent proposed collection efforts; DQOs will then be revised accordingly. As the overall understanding of site conditions improves and the range of potential remedial alternatives is narrowed, data gaps will become more limited.

The following text summarizes the DQO process performed for the TAN Groundwater RI/FS and presents the resulting data quality objectives.

4.1 Decision Types

This part of the DQO process is undertaken to define the problem, identify alternative courses of action that address the problem, and identify potential inputs affecting the decision.

4.1.1 Available Information

Based upon available data, a conceptual site model was developed for the TAN Groundwater RI/FS (see Section 3). Conceptual models describe a site and its environs and present hypotheses regarding the contaminants present, their routes of movement, and their potential impacts on sensitive receptors. The conceptual model indicates that there is a potential for exposure to unacceptable concentrations of TCE and other volatile organics. Tetrachloroethylene, 1,1 dichloroethylene, tritium, strontium-90, mercury, and lead may also be in the groundwater at unacceptable concentrations (see Table 4-1). Exposure from current use is basically limited to workers and visitors, as the affected site is under institutional control. Institutional responses to the identified problem are now in place (i.e., sparging system and routine drinking water analysis), which mitigate this risk. An industrial current land-use scenario will be evaluated in the baseline risk assessment under a no-action alternative. A residential/agricultural future land-use scenario will also be evaluated in the baseline risk assessment. The specific exposure pathways that will be evaluated are the ingestion of groundwater and inhalation of volatiles. A secondary exposure pathway that may be evaluated, depending on the results of the primary pathway analysis, is the ingestion of soil and crops as affected by the contaminated groundwater.

4.1.2 Alternative Courses of Action

There are three general courses of action that potentially address the groundwater contamination problem. The alternatives include:

- Characterizing the site further to define the extent of contamination and to develop a list of remedial alternatives
- Recommending "no action"
- Conducting a response action to try to mitigate the immediate threat.

Table 4-1. Preliminary contaminant list and their respective MCLs, risk-based concentrations, and detection limits.[a]

Chemical	MCL (ug/L)	Risk at MCL	Risk-based concentrations			Detection Limits (ug/L)
			Risk=10-6 (ug/L)	Risk=10-4 (ug/L)	HI=1 (ug/L)	
1,1 Dichloroethylene	7	1.0E-4	0.07	7	300	0.50
Trichloroethylene	5	2.0E-6	3	300	NA	0.50
Tetrachloroethylene	5	2.0E-6	1	100	400	0.50
Lead	5	NA	NA	NA	NA	3.0[b]
Mercury	2	NA	NA	NA	10	0.20[b]
Radionuclides[c]	MCL (pCi/L)		(pCi/L)	(pCi/L)	(pCi/L)	Quantitation Limits (pCi/L)
Stontium-90	8	1.0E-5	0.60	60	NA	1.0
Tritium	20,000	1.0E-4	357	35,700	NA	500

a. The data that support this list of contaminants are contained in the appendices of the RI/FS Work Plan. The contaminants were taken from validated data from 1989 and 1990 groundwater sampling and include only those contaminants that were found in both years. Contaminants found in only one year at low levels (<15 ppb) or in the unvalidated 1990 sludge data were not included in this list because they were not considered to be significant problems. These contaminants included methylene chloride, chloroform, toluene, 2-butanone, 1,2-dichloroethane, carbon tetrachloride, vinyl chloride, chlorides, sulfates, aluminum, barium, chromium, copper, iron, manganese, nickel, and zinc.

b. Value given is Quantitation limit.

c. These radionuclides have been found in the groundwater and/or the sludge. Three other radionuclides found in the sludge were not included in this list because they were not found in the groundwater (americium-241, eropium-154, and plutonium-239). Two radionuclides, cesium-137 and cobalt-60 were found in the groundwater but at very low levels and were found to be in the safe risk range.

4.1.3 Inputs Affecting the Decision

The objective of a remedial action program is to determine the nature and extent of release or threat of release of hazardous substances and to select a cost-effective remedial action to minimize or eliminate that threat. Achieving this objective requires that several interrelated activities are performed, each having objectives, acceptable levels of uncertainty, and attendant data quality requirements. The expression of these objectives in clear, precise decision statements is the first step toward the development of a cost-effective data collection program (EPA, 1987b). The decision framework for deciding on an appropriate action for the TAN 1-07B RI/FS can be summarized with the following questions:

1. What contaminants are present?
2. What are the concentrations of these contaminants in the environment?
3. Where are the contaminants located?
4. What is the potential for the contaminants to move within the environment?
5. Is there a significant source of contaminants still associated with the injection well [sludge or residual dense nonaqueous phase liquid (DNAPL)]?
6. Does the contamination pose an unacceptable risk?
7. What actions are recommended to deal with any unacceptable risk?

During scoping meetings between the Department of Energy (DOE), the Environmental Protection Agency (EPA), and the State of Idaho, it became apparent that some of the above questions could not be adequately addressed; therefore, additional site characterization and the development of remedial alternatives was considered necessary. Additionally, an interim action was considered necessary to remove contaminants from the TSF-05 injection well.

Existing data (as discussed in Section 2) are sufficient to answer Questions 1 and 2 with an acceptable degree of confidence at least with respect to the primary source, the TSF-05 injection well, and in the shallow parts of the aquifer. The primary contaminants for this RI/FS are TCE, PCE, lead, and strontium-90. Tritium, mercury and 1,1-DCE may also be constituents of concern.

Questions 3, 4, and 5 represent parameters for which the greatest degree of uncertainty exists; therefore, obtaining data to answer these questions represents the primary focus of RI and interim action activities. Additional data will be obtained as a result of the proposed interim action (see attached addendum), which will be conducted concurrently with the remedial investigation.

A baseline risk assessment will be performed to estimate the risk to people and the environment from the contaminants that are found to be present. The baseline risk assessment will answer Question 6.

Feasibility studies will be performed concurrently with the remedial investigation, with preliminary screening and alternative identification beginning early in the process, and alternative screening and selection occurring once the contaminants have been identified, and their location and concentration established. Question 7 will be answered through both the baseline risk assessment and the alternatives identification.

The approach identified was based on existing data, its applicability to meet decision needs, and the decision framework required to reach a Record of Decision for remediation of the operable unit. The decision framework for TAN Groundwater RI/FS activities is summarized in Figure 4-1.

4.2 SPECIFYING THE DOMAIN OF THE DECISION

In order to bound the RI/FS with respect to the extent of contamination, risk assessment, and remedial alternative evaluation, the operable unit is defined here to include the TSF-05 injection well and other direct groundwater disposal sites (i.e., IET and WRRTF injection wells), and the associated groundwater system. Furthermore, the operable unit is defined as that portion of the aquifer for which specific analytes of concern (i.e., TCE, PCE, lead, mercury, tritium, 1,1-DCE, and strontium-90) exceed action levels.

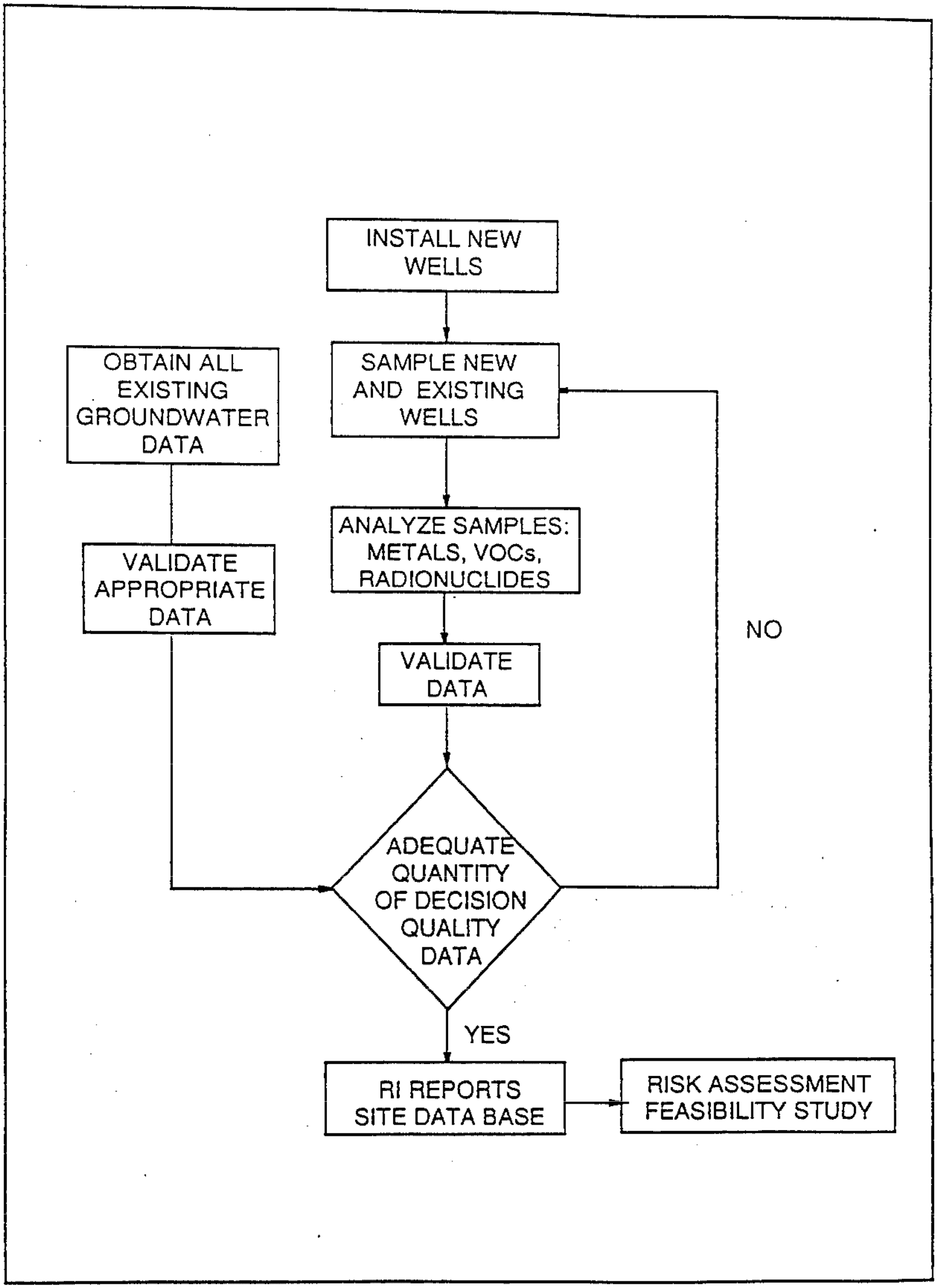


Figure 4-1. Decision tree TAN groundwater RI/FS sampling.

Under current use, only INEL workers (including contractors) and visitors to the site will be considered with respect to risk assessment. Institutional response actions such as the air sparging system and routine drinking water analysis will not be used in the risk evaluation of the current use industrial scenario. However, the mitigating effects of these response actions with respect to current use risk will be addressed in the BRA. The future residential/agricultural land-use scenario will be evaluated after a period of institutional control. The period of institutional control will be based on the length of current and planned operations plus the period of time required for decontamination and decommissioning of the facilities in compliance with 10 CFR 61.

The decision criteria for defining the extent of the problem for the TAN groundwater system will be a combination of risk calculations and ARARs. Acceptable groundwater concentration action levels will be determined using ARARs for the current use scenario. Risk calculations will be used to determine acceptable groundwater concentrations for future use scenarios. The preliminary federal and state ARARs identified for the TAN groundwater system have been incorporated into the Work Plan as an addendum.

To provide the appropriate quantity and quality of information needed to answer the questions posed in Section 4.1.3, data collection activities will be carried out during the FY-92 and FY-93 timeframe.

Data collected during the RI will be used as input parameters for contaminant transport modeling to predict future concentrations of TCE, 1,1-DCE, PCE, mercury, strontium-90, tritium, and lead. Existing data collected during FY-89 and FY-90 and the results of modeling efforts will then be used during risk evaluations. Remedial investigation results will also be used as necessary. Concentrations of contaminants will be predicted at decision points, which include the TAN and WRRTF production wells. Future use will assume groundwater use (i.e., a well drilled) at the point of greatest predicted concentration of the modelled contaminants in the plume.

Current use is based on the ability to supply water that meets current Safe Drinking Water Act requirements to the workers at TAN. Future use is based on the risk to agriculture or the resident population from the use of water pumped from the aquifer. If predicted maximum concentrations of contaminants exceed acceptable levels, then remedial action or alternative response actions will be evaluated to reduce the risk level. Additionally, it may be necessary to assess the accuracy of predictions. This assessment could include groundwater quality monitoring and updating modelled predictions.

4.3 DATA USES AND NEEDS

This stage of the DQO process defines data uses and specifies the types of data needed to meet the project objectives. The major elements of this stage of the DQO process include

- Identifying data uses
- Identifying data types
- Identifying data quantity/quality needs
- Reviewing precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters.

4.3.1 Data Uses

Most data uses during the RI/FS fall into one or more of five general categories, namely site characterization, public health evaluation and risk assessment, evaluation of remedial action alternatives, engineering design of alternatives, and worker health and safety. Data objectives and the type of data needed to meet the objectives are identified on Table 4-2. Intended data uses for each data type are identified on Table 4-3.

Site characterization refers to the determination and evaluation of the physical and chemical properties of the waste and contaminated media present at the operable unit, and an evaluation of the nature and extent of contamination. Site characterization for the TAN Groundwater RI/FS will involve the collection of necessary geologic, hydrologic, and water quality data through drilling, sampling (lithologic and groundwater), and aquifer testing.

Data collected to support the evaluation of remedial action alternatives include site characteristics and engineering information required for initial screening of alternatives, feasibility-level design, and preliminary cost estimates, as well as data required to support performance assessment. Information from the RI on the vertical and horizontal extent of contamination will be used in evaluating alternatives.

Data collected during the RI/FS can be used to develop a preliminary data base for engineering design purposes. Data types collected during the RI/FS that support this use include waste characterization and preliminary volume estimates. Much of this data will be obtained as a result of site characterization activities.

The worker health and safety category includes information collected to establish the level of protection needed for investigators or workers at the site. Also, the data will help to identify any concerns for resident populations living within the vicinity of the site.

4.3.2 Data Types

The data use categories just described define the general purpose and intent for collecting additional data. Based on the intended uses, a concise statement regarding the data types needed can be developed. The data types specified at this stage need not be limited to chemical parameters but should also include necessary physical parameters such as bulk density, hydraulic conductivity, etc. (see Tables 4-2 and 4-3).

4.3.2.1 Snake River Plain Aquifer. To refine the current understanding of the subsurface stratigraphy, local groundwater gradients, and aquifer properties, and to characterize the water quality of Snake River Plain Aquifer and the vertical extent of contamination, additional characterization/ monitoring wells will need to be installed. The data types to be collected for the RI are identified in Tables 4-2 and 4-3.

During both scoping meetings and subsequent discussions between DOE, EPA, and the State of Idaho, seven groundwater monitoring wells were considered the minimum acceptable to obtain the information necessary for risk assessment, fate and transport modeling, and remedial alternative evaluation. Groundwater sampling and contamination removal from the TSF-05 injection well (see the Interim Action addendum) will be carried out to provide additional data.

Table 4-2. Data quality objectives—TAN Groundwater Operable Unit RI

Data Objectives	Data Needs	Data Types
Regional Aquifer		
• Identify pathways for contaminant movement	• Stratigraphy, structure	• Geologic logging Geophysical logging
• Determine movement rate, direction, and dispersion of contaminants so that changes in the plume over time can be modelled. Provide input parameters for fate and transport modelling	• Hydrologic conditions Elevation	• Groundwater elevation • Aquifer parameters
	• Properties of sedimentary interbed	• Physical properties • Geochemical and mineralogical properties
	• Properties of the basalt	• Mineralogical and Geochemical properties
• Determine presence or absence of contaminants and spatial distribution of contaminants	• Water quality in new wells drilled as part of the RI	• Volatile organics • Metals • Radionuclides • General properties • Inorganics
• Determine presence or absence of contaminants and spatial distribution of contaminants. Determine temporal effects of 1990 sludge removal from the TSF-05 injection well.	• Water quality in all existing wells	• Volatile organics • Metals • Radionuclides • General properties • Inorganics

Table 4-3. Measurement approach for meeting data quality objectives for the RI/FS of the TAN Groundwater Operable Unit—Snake River Plain Aquifer

Data Type	Measurement	Analytical Method	Required Analytical Level	Data Use[a,b]
Geological logs	Visual	ASTM D2488-84	I	SC, EA, ED
Geophysical logs	Caliper logging	FSM/FSP	I	SC, EA, ED
	Natural Gamma logging	FSM/FSP	I	SC, EA, ED
	Neutron epithermal neutron logging	FSM/FSP	I	SC, EA, ED
	Gamma-gamma (density) logging	FSM/FSP	I	SC, EA, ED
Groundwater elevation	Static water level	FSM/FSP	Vertical ±0.01 ft or as achievable	SC, EA, ED
Aquifer parameters	Slug tests (standard pneumatic) and straddle packer pumping tests	FSM/FSP	I	SC, EA, ED
Sedimentary Interbeds				
Physical properties	Hydraulic conductivity	ASTM D2434 or MDSA (p694 and 700)	III	SC, EA, ED
	Porosity	ASTM D4531	III	SC, EA, ED
	Bulk (density)	ASTM D4531	III	SC, EA, ED
	Particle size distribution	ASTM D422-63	III	SC, EA, ED
Mineralogical and Geochemical properties	X-ray diffraction	ASTM D934-80	III	SC, EA, ED
	Cation exchange capacity	SW846-9081	III	SC, EA, ED
	Total organic carbon	MOSA, Part 2, 539	III	SC, EA, ED
Basalt				
Mineralogical and Geochemical properties	X-Ray diffraction	ASTM D934-80	III	SC, EA, ED
	Cation exchange capacity	SW846-9081	III	SC, EA, ED
Water (New RI Wells)				
Chemical properties	Volatile Organics	EPA 524.2	IV	SC, EA, ED, RA
	Metals	CLP	IV	SC, EA, ED, RA
	Radionuclides	RMTA	IV	SC, EA, ED, RA
	Additional Water Quality Analytes	See Table 3-9, FSP	III	SC, EA, ED, RA
General properties	pH	FSM/FSP	II	SC
	conductivity/TDS	FSM/FSP	II	SC
	Temperature	FSM/FSP	II	SC
	Dissolved Oxygen	FSM/FSP	II	SC

Table 4-3. (continued)

Data Type	Measurement	Analytical Method	Required Analytical Level	Data Use[a,b]
Water (New RI Wells) (cont.)				
Chemical Constituents (groundwater samples from straddle-packer pumping of isolated zones during drilling)	Volatile Organics	SW846-8010	II	SC
Water (Existing Wells)				
Chemical properties	Volatile organics	EPA 524.2	III	SC, EA, ED, RA
	metals	CLP	IV	SC, EA, ED, RA
	Radionuclides	RMTA	IV	SC, EA, ED, RA
	Additional Water Quality Analytes	See Table 3-9 FSP	III	SC, EA, ED, RA
General properties	pH	FSM/FSP	II	SC
	Conductivity/TDS	FSM/FSP	II	SC
	Temperature	FSM/FSP	II	SC
	Dissolved Oxygen	FSM/FSP	II	SC

a. Analytical data for which CLP protocols are applicable will be Analytical Level IV for use in evaluation of alternatives (EA) and risk assessment (RA). Other physical, geologic, chemical, visual, geophysical, radiological, and general properties data designated Analytical Level I, II, III, or V may also be used in the EA process. Where practical, non-CLP measurements/methods will include equivalent QA/QC and documentation to meet Analytical Level IV criteria.

b. Geological, hydrological, geochemical, mineralogical, and physical property data will be used as input parameters for fate & transport modelling for the RI. Groundwater quality data will be used for both the baseline risk assessment and fate & transport modelling.

Key:

RMTA	-	Radiological Master Task Agreement
ASTM	-	American Society for Testing Materials
CLP	-	Contract Laboratory Program
EA	-	evaluation of alternatives
ED	-	engineering design
EPA 524.2	-	volatile organic method found in EPA (1988)
FSM/FSP	-	field sampling method found in the Field Sampling Plan
MOSA	-	methods of soil analysis (Part 1, Physical and Mineralogical Methods, A. Klute, [Editor], 1986, American Society of Agronomy, Inc., Soil Science Society of America, Inc.)
QA/AC	-	quality assurance/quality control
RA	-	risk assessment
SC	-	site characterization
TDS	-	total dissolved solids

4.3.2.2 Air. The meteorological data available for the operable unit consists of wind rose information from meteorological stations located on the INEL (see Section 2 and references therein). Existing data will be used for the risk assessment to evaluate potential releases and exposures of contaminants via the air pathway.

4.3.2.3 Biota. The INEL has been the focus of research aimed at understanding the complex interactions of biota with contaminants at the Site. A discussion of studies undertaken in those areas can be found in Section 2.1.7 and cited references. Biota will not be considered during the risk assessment.

4.3.3 Data Quality Needs

The various tasks of a remedial investigation typically require different levels of data quality. Important factors in defining data quality include selecting appropriate analytical levels and identifying contaminant levels of concern, and then evaluating these elements with respect to risk-based levels.

In general, increasing accuracy and precision are obtained with increasing cost and time. Therefore, the analytical level used to obtain data should be commensurate with the intended use. Table 4-1 presents the contaminants of concern for the operable units and their respective MCLs and risk-based concentrations. Individual DQOs and the appropriate analytical levels associated with each data need are given in Table 4-3. Table 4-4 defines five analytical levels based on overall data quality.

4.3.4 Data Quantity Needs

The number of samples that need to be collected during an RI/FS can be determined by using several approaches. In situations for which data are lacking or are limited, a phased sampling approach may be useful. For areas of particular concern, critical and confirmation samples should be identified. All of these approaches have been utilized to determine the data quantity needs for the RI. Section 5 of the Work Plan and the Field Sampling Plan provide the supporting rationale for the quantity of data to be collected.

Table 4-4. Analytical levels[a]

Level I	Analyses done by on-site instrumentation primarily used for monitoring air for health and safety purposes (e.g., organic vapor monitoring instruments). Limited quantitative information can be gathered along with limited qualitative information (e.g., presence of volatile organics, not which compound is present) (see Reference 1 ERD PD 5.5, "Obtaining Laboratory Services").
Level II	Analyses done by field instrumentation or in a mobile laboratory that provides qualitative as well as quantitative results (e.g., portable x-ray fluorescence or gas chromatograph). Data from these analyses can be used for site characterization and monitoring during remedial activities (see Reference 1 ERD PD 5.5, "Obtaining Laboratory Services").
Level III	Analyses done by any approved laboratory procedure [i.e., approved by American Society for Testing and Materials (ASTM), the EPA, the ERD Independent Review Committee (EIRC), the USGS, etc.]. Data from these analyses can be used to confirm analyses performed by Level II techniques, evaluate engineering design, etc. (see Reference 1, ERD PD 5.5, "Obtaining Laboratory Services").
Level IV	Chemical analyses done by any EPA-approved method or any radiological analyses by method as specified by the Radiological Statement of Work. The laboratory deliverables consists of an EPA Contract Laboratory Program (CLP) type data package or the data package for chemical analyses specified by the Statement of Work for radiological analyses.
Level V	Analyses done by modified approved methods. The EPA Special Analytical Services and EIRC-approved methods for experimental analyses in unusual matrices are examples of Level V support. These data are also used for decisions requiring the highest level of confidence in the data (see Reference 1 ERD PD 5.5, "Obtaining Laboratory Services").

a. EG&G Idaho, Environmental Restoration Department.

4.3.5 PARCC Parameters

The PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters are indicators of data quality. Ideally, the end use of the data collected should define the necessary PARCC parameters. Once the PARCC requirements have been identified, then appropriate analytical methods can be chosen to meet the goals and requirements established. A discussion of the PARCC requirements for the RI are discussed in the Quality Assurance Project Plan.

5. RI/FS Tasks

Number

5. RI/FS TASKS

This section outlines the remedial investigation/feasibility study (RI/FS) activities that will be performed for the TAN Groundwater Operable Unit. The end product of the RI/FS process is a Record of Decision (ROD) for each operable unit addressed by the process. The RI/FS process shown in Figure 1-1 in Section 1 will be applied to the goal of obtaining a ROD for the Test Area North (TAN) Groundwater RI/FS (OU 1-07B) at the Idaho National Engineering Laboratory (INEL). The RI/FS process encompasses three separate, but related activities. They are:

- Remedial Investigation—develops data
- Risk assessment—quantitatively estimates risks
- Feasibility Study—evaluates remedial action alternatives.

The objectives of an RI are to collect and organize validated, existing data, and collect, validate, and organize new data to provide a data base for risk assessments and remedial action selection and design. Based on the need to supplement existing data, a RI will be performed that includes field work, laboratory work, data collection, interpretation, and reporting.

Risk assessments are required in the RI/FS process. For the TAN Groundwater RI/FS, a baseline risk assessment will be performed that will identify the risks of the no-action alternative to people and the environment.

To develop a remedial design that meets the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan, a feasibility study (FS) will be performed. The study will use as necessary, screening analyses, treatability studies, data obtained from the interim action, and engineering studies to identify, evaluate, and select a remedial action to reduce unacceptable risks identified at the TAN Groundwater Operable Unit.

The thirteen items listed below may be developed as part of the TAN Groundwater Operable Unit RI/FS:

1. Project Management Plan (PMP)

2. Community relations activities
3. Field investigations
4. Sample analysis and data validation
5. Data analysis
6. Risk assessments
7. Treatability studies (if necessary)
8. RI report
9. Alternative screening
10. Alternative analysis
11. Feasibility study
12. Proposed Plan and Record of Decision
13. Applicable or relevant and appropriate requirements (ARARs) analysis.

The following sections describe the activities within each item. The field investigation section describes the new field data collection activities. Specific details of field activities are described in the Field Sampling Plan (FSP), a companion document to this Work Plan. Applicable or relevant and appropriate requirements are discussed in an addendum to this Work Plan. In addition to the thirteen items listed above, an interim action is proposed that will run concurrently with the RI/FS. Specific details of the interim action are described in an attached addendum to this Work Plan.

5.1 Project Management Plan

The guiding PMP for the TAN Groundwater Operable Unit RI/FS will be the *Implementing Program Management Plan (IPMP) for the EG&G Idaho Environmental Restoration Department* (EG&G Idaho, 1991a). Site-specific PMP requirements not covered in the IPMP or the other sections of the Work Plan are covered in the following sections.

5.1.1 Introduction

The PMP introduction is covered in detail in Section 1 of this Work Plan.

5.1.2 Workscope

5.1.2.1 Purpose. The purpose of this PMP is to define the tasks necessary to support RI/FS activities for the TAN Groundwater Operable Unit at the INEL under CERCLA.

This PMP identifies the management process and the interfaces that will be used during the performance of the RI/FS process. This plan includes the sections listed below.

- Introduction
- Workscope
- Work Breakdown Structure
- Project Organization and Responsibilities
- Schedule
- Budget
- Resource Allocation Plan
- Quality Program Plan
- Environmental Safety and Health
- Security
- Project Management, Measurement, and Control Systems
- Institutional and Public Interactions
- Configuration Management
- Reporting.

5.1.2.2 Background. The site background and initial evaluation of the TAN Groundwater Operable Unit are described in detail in Sections 2 and 3 of this RI/FS Work Plan, as well as in the RFI Work Plan (EG&G Idaho, 1988).

5.1.2.3 Scope. The work scope is defined in Section 1 of this RI/FS Work Plan.

5.1.2.4 Deliverables. Deliverables required by the RI/FS process include the RI/FS Work Plan, various operational and administrative plans (health and safety, quality assurance, data management, community relations, sampling and analysis, etc.), and various reports that become part of the Administrative Record for the operable unit. The major reports required in the RI/FS process are the RI report and the RI/FS report that result in the ROD. The RI report is a documentation of efforts in the RI process, and the final RI report will include all characterization reports and other pertinent documents (i.e., baseline risk assessment, fate and transport modeling). The RI/FS report includes the results of the remedial alternatives development, screening, and analysis. The ROD will include any background information, RI/FS data, a summary of remedial alternatives considered, a responsiveness summary (prepared in response to public comments), and performance levels, which provide a baseline for demonstrating remedy effectiveness and compliance with other environmental regulations.

5.1.2.5 Constraints. Weather is the primary constraint that applies. Since much of the work will be performed outside in the arid, harsh climate of the high mountain plateau at INEL, the weather could impact the schedule, particularly of characterization and remedial implementation activities.

5.1.2.6 Key Assumptions. The schedule presented in this PMP is based upon the present knowledge of requirements and a best estimate of time required to complete a given effort. As more information is gathered and changes in requirements occur with Remedial Project Manager concurrence, the schedule will be adjusted accordingly.

5.1.3 Work Breakdown Structure

The Work Breakdown Structure (WBS) describes the planned activities to accomplish the objectives of the RI/FS process for this project (Figure 5-1). The activities identified by the WBS include the following:

- Project management
- RI/FS Work Plan development
- Interim action(s)
- Remedial investigation/feasibility study support
- Preparation of the final RI and FS reports
- Proposed Plan and ROD preparation support.

The activities shown in the WBS are described below.

5.1.3.1 TAN OU 1-07B Project Management. The responsibilities of the TAN OU 1-07B Project Manager are to assist the TAN Waste Area Group 1 Manager in providing project management of the remedial action activities of the TAN Groundwater Operable Unit to meet the requirements of the CERCLA RI/FS process. This includes compliance with applicable or relevant and appropriate requirements, and to integrate environmental assessment requirements into the RI/FS process as required by Department of Energy (DOE) policy.

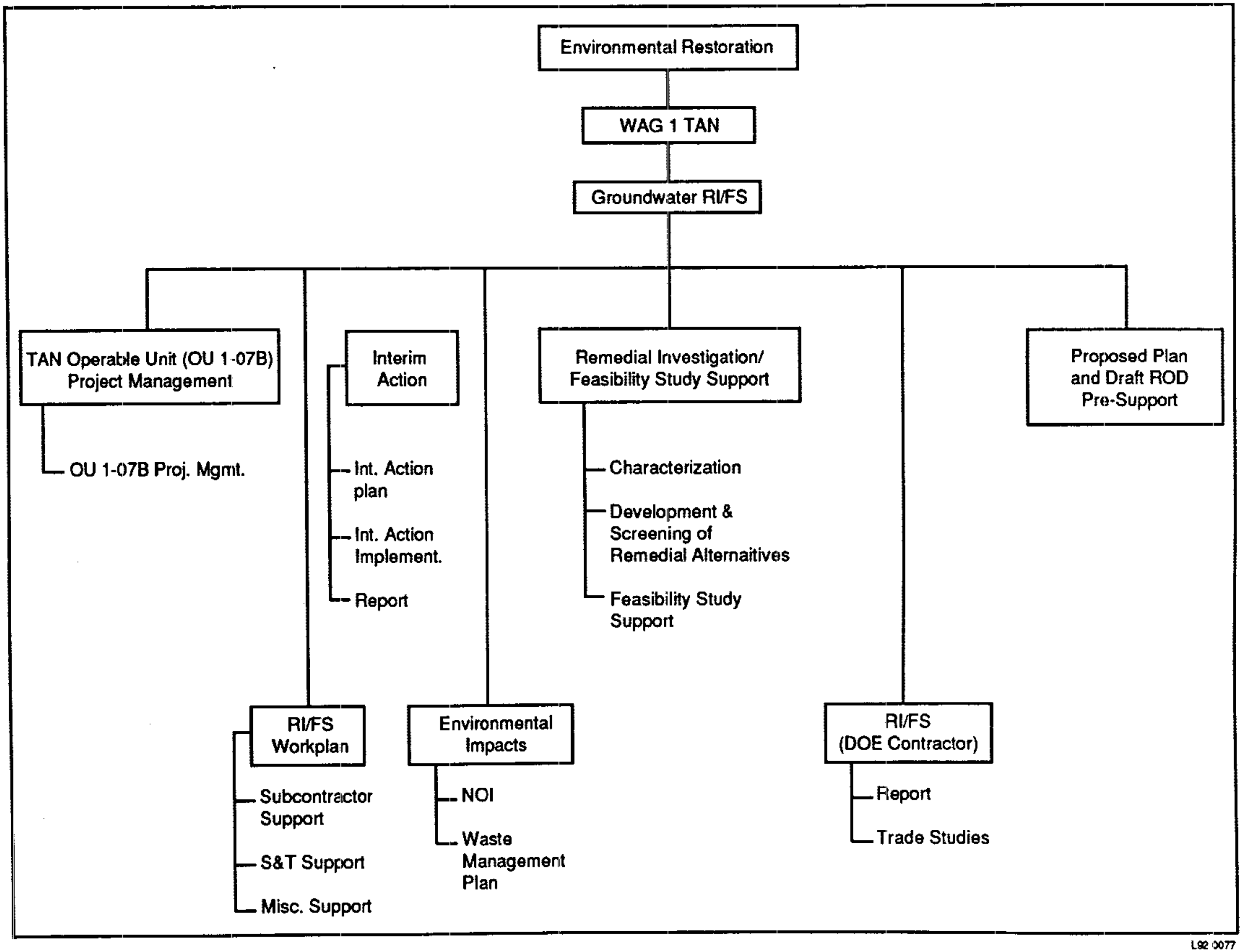


Figure 5-1. WBS for the TAN Groundwater Operable Unit.

5.1.3.2 **RI/FS Work Plan.** The RI/FS Work Plan documents and describes the work to be accomplished in the RI/FS process. The phases and associated activities are described below.

- Scoping is the initial planning phase of the RI/FS process and includes the collection and analysis of existing data; identification of the initial project operable unit, likely response scenarios, and remedial action objectives; initial identification of federal and state chemical- and location-specific ARARs; identification of data quality objectives (DQOs); and preparation of project plans.

- Site characterization includes field investigations (sampling and laboratory analysis) to define the nature and extent of contamination (waste types, concentrations, and distributions). DQOs and ARARs are revised based upon better understanding of the site. A baseline risk assessment is conducted, and a preliminary site characterization summary is prepared.

- Development and screening of alternatives begins during and after the site characterization and requires: identifying remedial action objectives; identifying potential treatment and containment technologies and disposal requirements that satisfy the remedial action objectives; screening the technologies based on effectiveness, implementability, and cost; and assembling technologies and associated containment or disposal requirements into alternatives for the contaminated media of the operable unit. Action-specific ARARs are identified.

- Treatability investigations, although not planned for this RI/FS, may be necessary to evaluate the application of a particular technology to specific site wastes.

- Detailed analysis of alternatives includes refinement of the alternatives, analysis of the alternatives with respect to the nine evaluation criteria the EPA has developed to address the statutory requirements, and a comparison of the alternatives against each other.

- Activities listed above will be documented in the RI and FS reports.

5.1.3.3 **Interim Action.** A detailed discussion of the proposed interim action for the TAN 1-07 Operable Unit is provided in an addendum to this Work Plan.

5.1.3.4 **Remedial Investigation/Feasibility Study Support.** RI/FS support includes all activities used to characterize the operable unit (i.e., the development and screening of remedial alternatives, treatability studies, the detailed analysis of alternatives, and the preparation of the draft RI and FS reports).

5.1.3.5 RI and FS Reports. The RI and FS reports will be completed and submitted to the EPA and the State of Idaho in accordance with the FFA/CO.

5.1.3.6 Proposed Plan and Draft ROD Preparation Support. The final RI and FS reports will be used to prepare the Proposed Plan and the draft ROD in accordance with the FFA/CO.

5.1.4 Project Organization, Responsibilities, and Authority

The organizational interfaces of the DOE-ID Environmental Restoration Department (ERD) are given in the IPMP.

EG&G Idaho's ERD Group Manager is responsible for the investigation and evaluation of environmental concerns at EG&G Idaho, which are designated as waste area groups (WAGs). The TAN Groundwater Operable Unit is included in WAG 1. The organizational breakdown structure for this project is given in Section A-2 of the Health and Safety Plan.

The WAG 1 TAN Project Manager is responsible for providing technical and administrative management to ensure each task in the TAN Groundwater RI/FS is completed on schedule in the most cost-effective manner possible. Additional duties include reporting and coordinating efforts with outside organizations including the DOE, the EPA, and the State of Idaho. The WAG 1 TAN Project Manager also provides technical direction to the TAN Groundwater RI/FS Project Manager.

The TAN OU 1-07B Project Manager reports to the WAG 1 TAN Project Manager and is responsible for managing the day-to-day activities, and for implementing and reporting the progress of the TAN OU 1-07B RI/FS.

5.1.5 Schedules

The schedule for RI/FS activities to the ROD is shown in Section 6 of this Work Plan.

5.1.6 Budgets and Cost Estimate

The budget for the TAN Groundwater RI/FS is provided in a cost account plan, which is available at the DOE WAG 1 Project Manager's Office.

5.1.7 Resource Allocation Plan

The plan for allocation of resources to accomplish this project is provided in a cost account plan, which is available at the DOE WAG 1 Project Manager's Office.

5.1.8 Quality Program Plan

The quality requirements of the Quality Program Plan for the Environmental Restoration Department (QPP-149) and the Quality Assurance Project Plan (QAPjP) for the TAN Groundwater RI/FS (attached as an addendum to this Work Plan) describe the implementation of the quality assurance (QA) and quality control (QC) requirements for executing the work identified in the RI/FS process for the TAN Groundwater Operable Unit.

5.1.9 Environmental Safety and Health

Environmental safety and health for the TAN Groundwater RI/FS will follow the requirements of EG&G Idaho (1989) and Morton (1991). A task-specific addendum to EG&G Idaho's ERD Health and Safety Plan (Morton, 1991) has been prepared for this project (attached as an addendum). All field work will be accomplished in accordance with this Health and Safety Plan, and all field work participants will review the plan before beginning field work.

5.1.10 Security

All work conducted to remediate the TAN Groundwater Operable Unit will meet all security requirements of the INEL. This project does not involve special nuclear material, classified information, or automated data processing equipment that processes classified or sensitive information. Therefore, a project-specific security plan is not required. Security arrangements for personnel and subcontractor access will meet all applicable security requirements of the INEL.

5.1.11 Project Management, Measurement, and Control Systems

Management of the TAN Groundwater RI/FS process will be in accordance with project management practices and principles identified in the EG&G Idaho Management Plan for the ERD. The designated project manager is responsible for implementation of approved management practices.

Work packages have been established to identify segments of the work and are included on the detailed project WBS. Work packages and work releases authorize work, and the personnel assigned responsibility for the work activities are responsible for reporting cost, schedule, and scope performance.

5.1.11.1 Planning. Project planning includes the major elements listed in the following sections.

5.1.11.1.1 RI/FS Scope of Work--The RI/FS Scope of Work defines the scope, schedule, and deliverables for the TAN Groundwater RI/FS.

5.1.11.1.2 RI/FS Work Plan--The RI/FS Work Plan constitutes the primary planning document for performance of the RI/FS process. The RI/FS Work Plan expands on the approved scope and schedule in the RI/FS Scope of Work.

5.1.11.1.3 Project Baseline--The project baseline includes the scope, schedule, and budget for the project. The project baseline will be based on detailed work package planning and will be used for comparing actual performance to the scope, schedule, and budget.

5.1.11.1.4 Work Authorization--The approved RI/FS Scope of Work (and eventually the final Work Plan) authorizes the Project Manager to proceed in accordance with the contents of the plan. Approved work package plans authorize work package managers to proceed in accordance with the contents of the work packages. Approval of work package plans establishes the scope, schedule, and budget of the work package baseline. Work to be performed by subcontractors will be authorized and initiated via subcontracts, or other approved practices in accordance with DOE-ID and EG&G Idaho's procurement procedures and regulations.

5.1.11.2 Project Control. Project controls outlined in the IPMP will be followed.

5.1.12 *Configuration Management*

This project will follow IPMP guidelines for configuration management and document control.

5.1.13 Reporting

Reporting requirements outlined in the IPMP will be followed.

5.2 COMMUNITY RELATIONS

Community relations are an integral part of any CERCLA action whether or not the action is on a federal facility. At the INEL, a DOE federal facility, all CERCLA actions will be subject to CERCLA community involvement requirements. A programmatic Community Relations Plan (CRP) has been prepared and is attached as an addendum to this Work Plan. The CRP will guide the actions taken to ensure appropriate public involvement in agency decision making.

5.3 FIELD INVESTIGATIONS AND DATA DEVELOPMENT

Field activities and data development activities were identified through the scoping process to fill data gaps for a number of the conceptual model compartments for the TAN Groundwater RI/FS (see Section 4). These activities can be grouped into the following subtasks:

- Well installation, aquifer testing, and subsurface sampling
- Groundwater sampling
- Existing data validation and analysis.

The following text describes these proposed activities. Specific details of drilling and monitor well installation, sampling, and analytical protocols for new data are provided in the Field Sampling Plan (FSP), an addendum to this Work Plan.

5.3.1 Well Installation and Subsurface Sampling

In order to understand the nature and extent of contamination and to identify the subsurface transport pathways from the TSF-05 injection well and other potential sources at TAN, a field investigation strategy has been developed. The RI and existing RFI data will provide the information necessary to define the lateral and vertical extent of contamination, as well as to identify subsurface hydrogeologic factors (i.e., interbeds) influencing the movement of contaminants. While the northern, eastern, and western lateral extent of TCE above the action limit of 5 μg/L is fairly well known in the shallow (200-400 ft bls) part of the aquifer, information on the vertical extent of TCE and other contaminants, the southern (SW, S, SE) lateral extent of contamination, the temporal effects of the 1990 sludge removal action from the injection well on groundwater TCE concentrations, and subsurface factors potentially influencing the migration of contaminants are unknown.

The field investigation strategy developed here and detailed in the Field Sampling Plan was based on the assumption that the Federal Drinking Water Standard primary Maximum Contaminant Level (MCL) of 5 μg/L TCE defines the extent of the contaminant plume. Additional wells are planned, which will supplement existing information obtained from wells drilled during the RCRA Facility Investigation and by the USGS.

Seven characterization/monitoring wells will be installed in the Snake River Plain Aquifer. Four of the wells will be drilled and installed as cluster well pairs (i.e., TAN-18, and TAN-19, TAN-22 and TAN-23). Three wells (TAN-20, TAN-21 and TAN-24) will be completed as single completion well sites. During monitor well drilling, samples of sedimentary interbeds will be collected from the TAN-19 and TAN-23 boreholes. These samples will be analyzed to determine physical, hydrologic, and geochemical properties that may affect the migration of contaminants. Additionally, groundwater samples will be collected and packer-pumping tests will be conducted on discrete intervals in each borehole during the drilling process. These activities will provide information on the vertical distribution of TCE as well as groundwater flow parameters. Detailed descriptions of these activities are presented in the FSP. The data will be used as input to numerical models (Section 5.5) to calculate the rate of contaminant movement.

The drilling of monitoring wells, the testing of the aquifer, and the analysis of groundwater samples collected from these wells will provide the following data:

- Detailed information on the subsurface stratigraphy and structure
- Additional piezometric control points
- Additional water chemistry and possible contaminant sampling points
- Information to better define the vertical and horizontal hydraulic gradients
- Water chemistry data to define the lateral and vertical extent of contamination
- Information to refine estimates of contaminant quantities in the aquifer.

Sampling of the sedimentary interbeds will provide the following additional data:

- Physical, hydrologic, and geochemical characterization of the sedimentary interbeds
- Identification of movement pathways.

The potential for residual DNAPL in the vicinity of the TSF-05 injection well will be evaluated using information obtained from both the proposed interim action and RI activities. Remedial investigation activities (well drilling, groundwater sampling, and existing data evaluation) will provide water quality and stratigraphic information (i.e., presence and continuity of interbeds) for use in this evaluation.

5.3.1.1 Location of the Seven Proposed Snake River Plain Aquifer Wells. The location of the proposed aquifer characterization wells is based primarily on the need to determine both the southern lateral extent of contamination and the vertical extent of TCE and other volatile organics. Available hydrologic data indicate that the local direction of groundwater flow is influenced by pumping of the TSF water supply wells; therefore, this factor, along with regional groundwater flow direction, was taken into account in determining the location of characterization/monitoring wells (see Figures 5-2a and 5-2b and Appendix F). Additionally, an evaluation of existing geologic and hydrologic data indicates that Q-R sedimentary interbed may be laterally continuous and thus potentially confining (see Section 2.1.6.6). This information was taking into account when determining initial well completion intervals.

Four wells will be completed as cluster well pairs and three wells will be constructed as single well completions in the Snake River Plain Aquifer as part of the remedial investigation. One well pair (TAN-18 and TAN-19) will be sited "in line" between the TSF-05 injection well and both the USGS-24 well and the TSF water supply wells (TAN-1 and TAN-2). This well cluster is sited cross gradient from the injection well based on regional groundwater flow and down-gradient based on local groundwater flow as influenced by the TSF production well pumping. The location of well cluster TAN-22 and TAN-23 is down-gradient from the TSF-05 injection well and adjacent to shallow

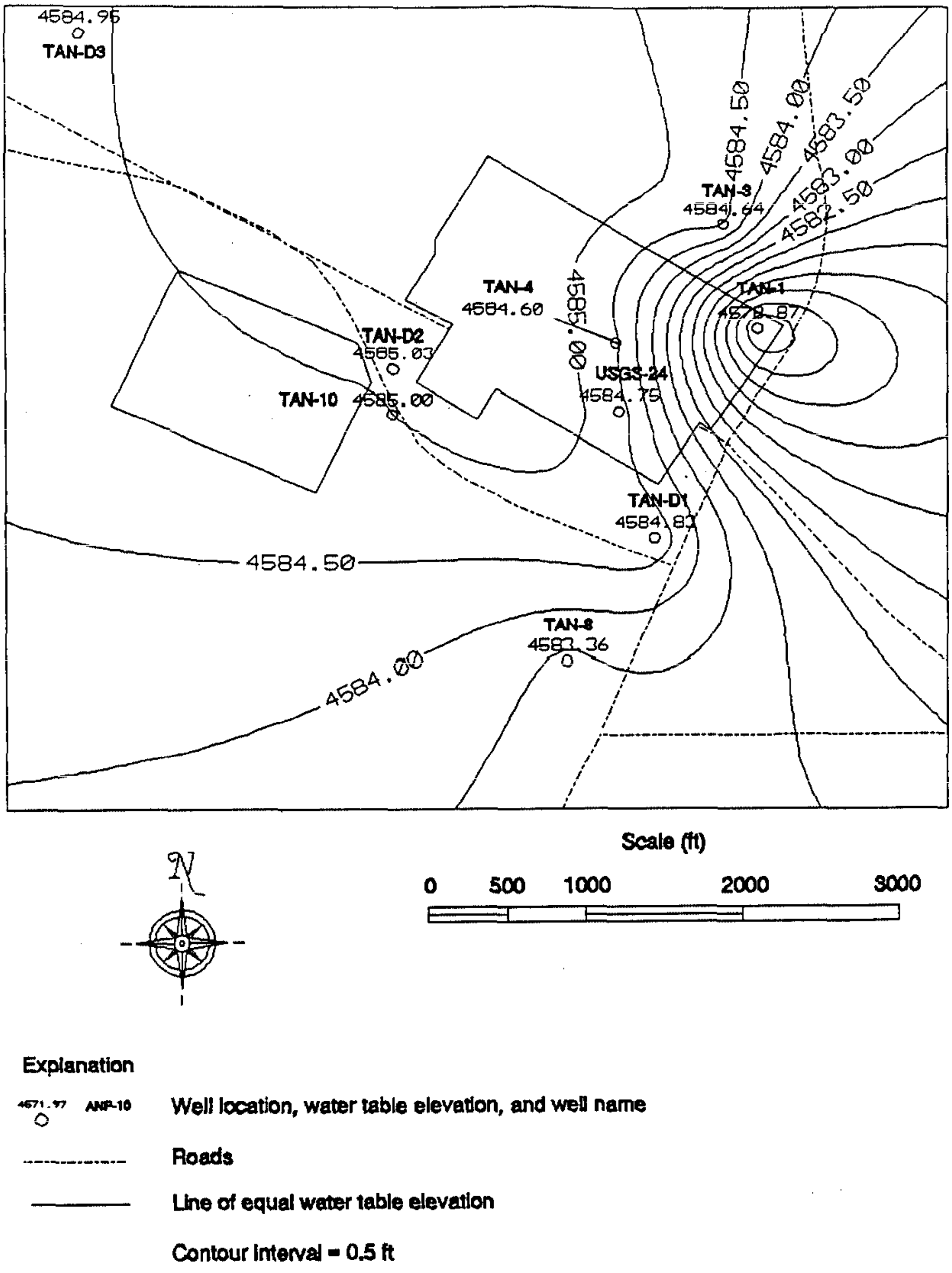
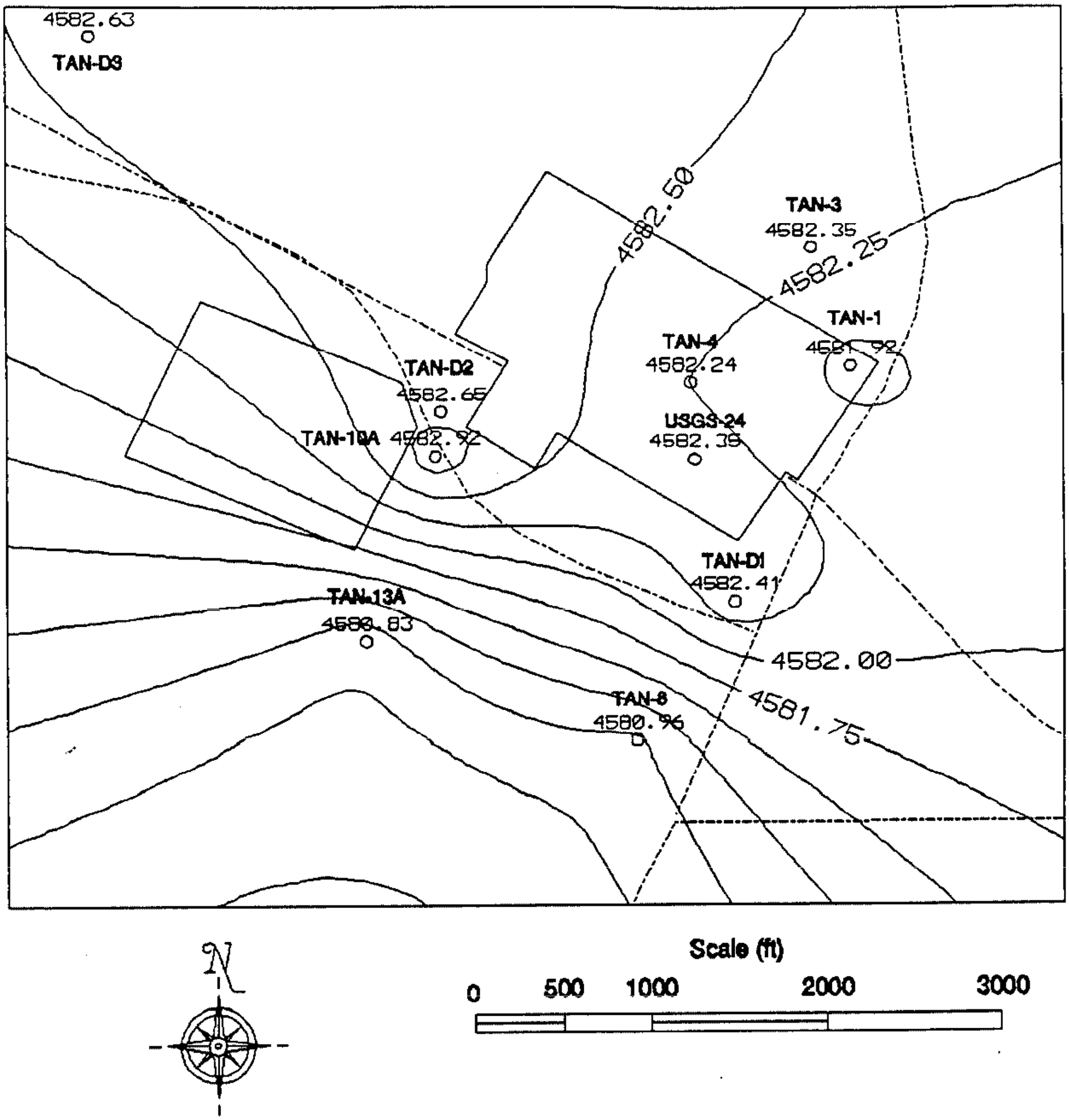


Figure 5-2a. May 1990 water table map of the TSF area at TAN showing the effects of production well pumping (pumping rate is 1,060 gpm: Contours generated using surfer).



Explanation

4671.97 ANP-10 ○	Well location, water table elevation, and well name
- - - - - - -	Roads
———	Line of equal water table elevation
	Contour interval = 0.25 ft

Figure 5-2b. December 1990 water table map of the TSF area at TAN with only minimal production well pumping effects (contours generated using surfer).

monitoring wells TAN-15 and TAN-16. Both TAN-15, which is screened above the P-Q sedimentary interbed at approximately 250 ft bls, and TAN-16 (screened below the interbed) have similar groundwater concentrations of TCE. One of the objectives of drilling and installing this well cluster is to provide information on the vertical extent of TCE near the center of the contaminant plume. A second objective is to determine whether or not the Q-R sedimentary interbed is present and if so, to determine the contaminant distribution across this potentially confining layer. One well (TAN-21) will be drilled and installed approximately midway between the TSF-05 injection well and the GIN wells at WRRTF along the anticipated southern boundary of the contaminant plume. The objective of this well is to define the southern lateral extent of the contamination plume. Monitor well TAN-20 will be drilled and installed southwest of the TSF-05 injection well (west of TAN-13A and TAN-14). This well will be used to evaluate whether or not contaminants disposed in the injection well are being dispersed along a south-southwest groundwater flow path, and are not affected by TSF-production well pumping. Monitor well TAN-24 will be drilled and installed down-gradient from the WRRTF production well ANP-8. TCE has been detected in ANP-8 above the MCL and in other WRRTF area observation wells. TAN-24 will provide a monitoring point down-gradient from WRRTF. Figure 5-3 shows the proposed locations of wells TAN-18, TAN-19, TAN-20, TAN-21, TAN-22, TAN-23, and TAN-24 and the general direction of groundwater flow in the Snake River Plain Aquifer based on regional mapping by the USGS.

5.3.1.2 Aquifer Well Construction. In general, completion depths for the seven monitoring wells will be based on the need to (a) determine vertical extent of TCE contamination, (b) define the southern (SW, S, SE) lateral extent of contamination, and (c) determine whether or not the Q-R sedimentary interbed is a factor in influencing the distribution and movement of contaminants. Based on the current understanding of the subsurface geology and hydrology (see Section 2.1.6), the Q-R interbed may be laterally continuous and thus semi-confining. Initial well completion depths were selected based on the above criteria and information.

- TAN-19 and TAN-23 will be completed below the leading edge of the contaminant plume in the first permeable zone where groundwater analytical results show that TCE concentrations are below the action

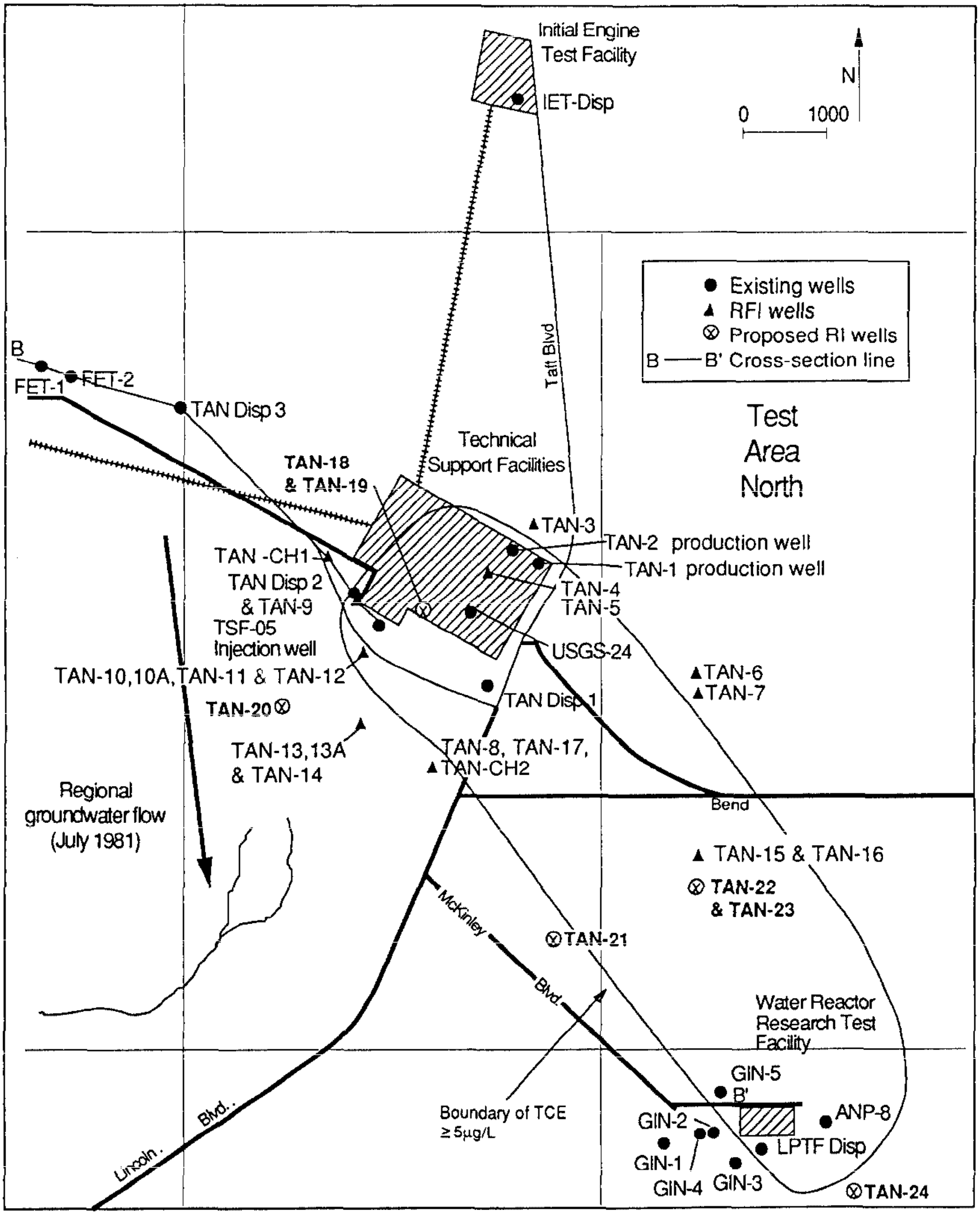


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Figure 5-3. Locations of proposed and existing Snake River Plain Aquifer wells on the vicinity of TAN.

level of 5 μg/L. It is anticipated that the first permeable zone below the Q-R interbed will be below the 5 μG/L MCL. If the Q-R interbed is not laterally continuous or if TCE at or above the MCL is detected at this interval, drilling will continue until groundwater TCE concentrations are shown to be below the MCL.

- TAN-18 and TAN-22 will be completed in the last permeable zone where TCE is detected at levels equal to or above the safe drinking water MCL of 5 μg/L (the leading vertical edge of the contaminant plume). It is anticipated that this zone will be at or above the top of the Q-R interbed. If the Q-R interbed is not a factor in constraining the distribution of contaminants, drilling will continue until the leading vertical edge of the TCE plume is identified.

- Wells TAN-20, TAN-21, and TAN-24 are being drilled to determine the lateral extent of TCE contamination in the southwestern, southern and southeastern direction, respectively. The wells will be completed in the last permeable zone where TCE is detected $\geq$5 μg/L. As with TAN-18 and TAN-22, it is anticipated that this depth will be at or above the Q-R interbed.

Permeable zones refer to basalt flow tops and bottoms or fracture intervals, and are readily distinguishable during drilling as a result of lost circulation or extensive caving.

All wells will be constructed as 4-in. monitoring wells as detailed in Section 5.1.2 of the FSP. During all drilling and well installation activities, a geologist will be present at the drill site to supervise the drilling, record the lithology, record the response of the drill rig, and direct, measure, and record the well construction details. After well installation, all wells will be developed and slug tests performed, as described in Section 5.1.5 of the FSP.

5.3.1.3 Subsurface Sampling. Sedimentary interbed samples below the water table will be collected as described in Section 5.1.3 of the FSP, and will have the following physical properties determined: hydraulic conductivity, porosity, bulk density, and particle-size distribution (see

Table 5-1). In addition, mineralogy by x-ray diffraction, carbon content, and CEC will be determined for the sedimentary interbed material. It should be noted that available subsurface data indicate that the sedimentary interbeds at TAN are generally thin (<10 ft); therefore, success in obtaining interbed samples is not certain. Basalt cores from two previously drilled core holes (TANCH-1 and TANCH-2) will be selected and analyzed for mineralogy by x-ray diffraction and cation exchange capacity. Basalt core samples will be selected from fracture zones or flow tops (e.g., zones of primary water and contaminant movement).

Data from analyses on the interbeds and basalts will provide information on hydrologic and geochemical parameters that affect the rate of movement of contaminants in the subsurface and will be used as input parameters for contaminant fate and transport modeling.

5.3.1.4 Aquifer Testing and Groundwater Sampling During Drilling. To accurately define or identify the vertical extent of TCE contamination and to obtain information on aquifer characteristics, an aquifer testing and groundwater sampling program will be conducted during the drilling process. Testing and sampling in the deep boreholes of each cluster (TAN-19 and TAN-23) and in TAN-20 and TAN-24 will commence at the first permeable zone encountered at a depth below the completion interval of the nearest already existing well (see Table 5-2). The shallow boreholes of each cluster will be tested and sampled at depths corresponding to anticipated completion depths. Testing and sampling in the TAN-21 borehole will commence at the first permeable zone below the water table. Aquifer testing and groundwater sampling will be repeated at selected permeable zones over the entire depth of the borehole (except in TAN-18 and TAN-22) as well as above the Q-R interbed. Testing and sampling below the Q-R interbed will only be carried out in boreholes TAN-19 and TAN-23. A detailed discussion of this program is presented in the FSP.

5.3.1.5 Slug Testing. All installed characterization wells will be hydraulically tested using a pneumatic slug test method. The slug test data will verify that the characterization wells are in good hydraulic communication with the Snake River Plain Aquifer. A discussion of the pneumatic slug test method is provided in Section 5.1.5 of the FSP. A

Table 5-1. Summary of location, media, sample type, and analysis - core and interbed samples

Location	Media[a]	Sample Type	Physical Property Samples[b]	Mineralogical and Geochemical Samples[c]
TAN-19 borehole	P-Q Interbed	TBD[d]	1	1
	Q-R Interbed	TBD[d]	1	1
TAN-23 borehole	P-Q Interbed	TBD[d]	1	1
	Q-R Interbed	TBD[d]	1	1
TANCH-1	Basalt	Core		2
TANCH-2	Basalt	Core		2

a. See Figures 1-5 and 1-6 in the Field Sampling Plan (FSP) and Table 5-2 of the Work Plan for the stratigraphic position of the interbeds.
b. See Tables 2-2 and 3-7 in the FSP for the tests and methods.
c. See Tables 2-2 and 3-8 in the FSP for the tests and methods.
d. Multiple sampling methods are anticipated to collect necessary samples (i.e., core, shelby, pitcher sampler, etc.).

Note: The P-Q and Q-R interbeds have been correlated using available geological and geophysical data.

Table 5-2. Approximate depths of the P-Q and Q-R interbeds, aquifer testing and groundwater sampling depths, and completion depths for the monitoring wells

Well	P-Q Interbed (ft bls)	Q-R Interbed (ft bls)	Initial Aquifer Testing and Sampling Depths (ft bls)	Additional Aquifer Testing and Sampling Depths (ft bls)	Completion Depth of Nearest Existing well (ft bls)		Approximate Completion Depth (ft bls)
TAN-18	200	415	415	NA	TSF-05	269-305	395-415
TAN-19 (deep)	200	415	340	380, 415, 450	TSF-05	269-305	430-450
TAN-20	195	415	415	NA	TAN-12	362-382	395-415
TAN-21	260	450	240	290, 340, 390, 450	NA	NA	430-450
TAN-22	260	450	450	NA	TAN-16	302-322	430-450
TAN-23 (deep)	260	450	355	400, 450, 480	TAN-16	302-322	460-480
TAN-24	330	520	325	375, 425, 475, 520	ANP-8	302	500-520

hydrogeologist will oversee the testing and analyze the results to determine well parameters. Once the monitoring wells are completed, selected wells will have continuous water level recorders installed to measure fluctuations in the water level and provide information about the hydraulic connection among the wells. Well selection for recorder installation will be based on the locations of monitoring wells with respect to potential pumping well influences, as well as on subsurface geologic information.

5.3.1.6 Well Surveying and Geophysical Logging. All wells will be located and surveyed after the installation of the well cap casing cover has been completed. A second-order survey of all wells on the INEL is being initiated under another program to establish a common datum for INEL wells. The RI wells will be included in this survey (see Section 5.2.4 of the FSP).

Geophysical logs will be run by the USGS on all newly drilled boreholes. The logs to be run will include neutron epithermal neutron, natural gamma, gamma-gamma, and caliper. Additionally, a video camera log will be run on all boreholes. The information obtained from the logging effort will be used for stratigraphic evaluations as well as for well construction analysis.

5.3.1.7 Characterization Well Evaluation. After completion of the characterization wells, all the data will be evaluated. Additional field characterization work is not anticipated with the exception of groundwater sampling and monthly water level measurements.

5.3.2 Groundwater Sampling

EG&G Idaho and the USGS monitor selected water quality parameters in the Snake River Plain Aquifer. The purpose of the proposed sampling effort is to extend the scope of the monitoring effort to include additional parameters and wells.

Two rounds of water samples will be collected and analyzed from a network of 37 monitoring and observation wells to include the TSF and IET injection wells (see Table 5-3 in this section and Figures 1-3 and 2-2 in the FSP for well locations). Because the WRRTF injection well has been abandoned and cannot be accessed for sampling, groundwater samples will be collected from

Table 5-3. Existing and new aquifer wells to be sampled (also see well equivalency table)

Existing Wells[a]	ANP-6, ANP-8, ANP-9, USGS-24, USGS-26, TAN-D1, TAN-D2, TAN-D3, IET-injection, TSF-05 injection, TAN-1, TAN-2, FET-2, GIN-2, GIN-4, TAN-3, TAN-4, TAN-5, TAN-6, TAN-7, TAN-8, TAN-9, TAN-10A, TAN-11, TAN-12, TAN-13A, TAN-14, TAN-15, TAN-16, TAN-17.
New Wells	TAN-18, TAN-19, TAN-20, TAN-21, TAN-22, TAN-23, TAN-24.

a. The GIN wells are uncased, open holes with total depths ranging from 306 to 430 ft bls and are all clustered within 200 yards of each other. GIN-2 (402 ft bls) and GIN-4 (306 ft bls) were selected for sampling to cover the interval from 306 to 430 ft bls. Additional sampling (i.e., using GIN-1, -3, and -5) would not add additional meaningful data.

Three wells were selected for upgradient groundwater monitoring (ANP-6, FET-02, and TAN-D3). Well FET-01 was not selected for monitoring because the open interval of FET-02 will cover the open interval of the adjacent FET-02 well.

nearby wells (GIN-2, GIN-4, ANP-8 and the RI well TAN-24) to provide groundwater quality data in this area. The first sampling event from the network wells will begin in April. The second round of groundwater sampling will be conducted in approximately the October-November time frame. The sampling dates correspond to high and low water levels for the Snake River Plain Aquifer (see hydrographs in Appendix F), thereby providing contaminant information with respect to seasonal fluctuation. Well purging and sample collection are described in detail in Sections 5.3.2 and 5.3.3 of the FSP.

For the existing monitoring wells constructed by the USGS, detailed construction and quality control procedures used during well installation are not always available; therefore, analytical support Level III for the chemical analysis and Level IV for radionuclide analysis on the groundwater collected from these wells is appropriate. Analytical support Level III for chemical analyses and Level IV radionuclide analysis on the groundwater samples collected from existing RFI wells (FY-89 and FY-90 investigation) will also be obtained. The analyses to be performed on these wells are listed in Table 5-4 and include volatiles (524.2), CLP metals, nitrates, sulfates, chloride, fluoride, alkalinity, and radionuclides (ERD Target Radionuclide List - see Table 3-12 in the FSP).

For groundwater samples collected from the wells installed as part of the remedial investigation, the desired level of analytical accuracy and precision for the chemical parameters is Level IV. The analyses to be performed on these water samples are also given in Table 5-4. These analyses include analytical support Level IV volatiles by 524.2, and metals following the EPA Contract Lab Program (CLP) Statement of Work (SOW); Level IV analysis for radionuclides (ERD Target Radionuclide List); and analytical support Level III analysis for alkalinity, nitrates, sulfates, chloride, and fluoride.

5.3.3 Subsurface Sediment Sampling

The potential for TCE and other contaminants being present in sediment/rock matrix of the TSF-05 injection well annular space will be

Table 5-4. Summary of location, media, sample type, and analysis-groundwater samples[a]

Location	Sample Type	Level III Volatiles (524.2)	Level IV Volatiles (524.2)	Level IV CLP Metals	Level IV Radio-nuclides[b]	Additional Water Quality Analytes[c]
Existing USGS and RI wells	Grab	30	--	30	30	30
New wells (RI)	Grab	--	7	7	7	7

a. Samples are from specific wells, and the number identified does not include QA/QC samples. QA/QC samples are discussed in the FSP.

b. Radionuclides to be determined are listed in Table 3-12 of the FSP.

c. See Table 3-6 of the FSP for additional water quality analyses to be conducted.

investigated as part of the interim action (see attached addendum). Information obtained from the interim action will be incorporated into evaluations of data from the RI.

5.3.4 Water Level Measurements

The regional groundwater flow at TAN is in a south to southeast direction. However, regional flow is affected by pumpage of the TAN area water supply (production) wells (see Figure 5-2).[e] These effects have a direct bearing on the direction and rate of contaminant migration and thus it is important to understand the groundwater flow system at TAN. Monthly water level measurements will be collected from available wells (see Table 5-5) within approximately a 1-1/2-mi radius of TAN. These wells will be eventually tied into a First-order vertical survey to be conducted by the National Geodetic Survey during the summer of 1992. To accurately define regional groundwater flow, water level measurements from wells potentially within the radius of production well pumping influence will be taken only after the production wells have been taken out of operation for a minimum of four hours. To determine the influence of production well pumping, a number of monitoring/observation wells have already been instrumented with transducers or Stevens recorders. Data gathered from this task will be presented as monthly water table maps and hydrographs and will be incorporated into the RI report.

5.3.5 Existing Data Validation and Analysis

Two previous groundwater sampling events at TAN have generated data that are potentially usable for meeting RI/FS data needs. The data generated by the 1989 and 1990 sampling events in which samples were collected and analyzed for selected organic, inorganic, and radiological contaminants, are potentially useful for site characterization, risk assessments, alternative evaluation, and remedial design. For these purposes, the data need to be fully validated and evaluated.

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e. Private communication with A. H. Wylie, 1990.

Table 5-5. Wells measured on a monthly basis for water level data.

ANP5	TAN7
ANP6	TAN8
ANP7	TAN9
ANP8	TAN10
ANP9	TAN10A
ANP10	TAN11
GIN1	TAN12
GIN2	TAN13
GIN3	TAN13A
GIN4	TAN14
GIN5	TAN15
IET DISP	TAN16
NONAM	TAN17
OWSLEY 2	TCH1
P&W1	TCH2S
P&W2	TCH2D
P&W3	TD1
PSTF	TD2
TAN1	TD3
TAN2	TSFDISP
TAN3	USGS7
TAN4	USGS24
TAN5	USGS25
TAN6	USGS26

Note: For alternate well names, see the well equivalency table located immediately following the table of contents.

The inorganic, organic, and radionuclide data have been only recently validated. Data validation efforts followed the INEL internal processes described by the QAPjP and the Data Management Plan (DMP). Summary tables of this data are presented in Appendices of this Work Plan. However, these data have not been evaluated for meeting the DQOs for decision quality data. To help meet the data needs for the TAN Groundwater RI/FS in a cost-effective manner, a separate RI task has been identified to evaluate and analyze all of these data so that as much of the data as possible will be available for use. Data summaries constructed from the validated data sets will be used for site characterization, risk assessment, and fate and transport modeling. Data analysis will focus on utilizing the validated data in concert with the new data to characterize the contaminants found in the groundwater.

5.4 Analysis and Validation

Samples of groundwater will be collected during the remedial investigation at TAN. The rationale for these samples is presented in Section 4 of this Work Plan (including the DQOs), and conceptual presentations of the locations of collection and the methods of collection are presented in Section 5 of this Work Plan. The FSP, an addendum to this Work Plan, describes in detail the field operations proposed for use in the collection of these samples.

The validation of data for use in making decisions on CERCLA sites is an important step in the RI/FS process. Data from samples collected at TAN (whether historical or new) will be validated using the EG&G Idaho ERD Sample Management Office's SOPs (12.1.1 - 12.1.5). The process of validating data is also discussed in the ERD Program Directive (PD) 2.4. Once the data are validated through this process, it will be transferred to the ERD Data Management System described in the DMP, a companion document to this Work Plan. Quality-assured data or results shall be submitted as they become available but no later than 120 days after collection.

5.5 DATA EVALUATION AND CONTAMINANT TRANSPORT MODELING

5.5.1 Data Evaluation

Data evaluation will begin after data validation has been completed. Data evaluation has two purposes: (a) to assess the need for additional sampling, and (b) to perform data interpretation.

Data evaluation to assess the need for additional sampling will be performed for the following field investigation tasks: well installation and subsurface investigation, and groundwater investigation. Once data are provided by the interim reports for these field investigations, another scoping session will be held to evaluate adequacy of the data for meeting RI/FS data needs (i.e., remedial selection, risk assessment, and remedial design data needs).

Interpretation of data begins when the validated data are entered into the Data Management System. The Data Management System will allow characterization of the concentration and extent of contamination. Computer-generated maps, tables, graphs, and figures will be developed to facilitate data assessment. Data evaluation will also include the use of models to predict contaminant behavior with changes in time and space. Model input will include data developed by the investigations. Model output will be used for site characterization, risk assessments, and remedial selection and design.

5.5.2 Contaminant Transport Modeling

Appendix H, Groundwater Code Selection for the TAN Groundwater Remedial Investigation/Feasibility Study (TAN-GWCS) addresses the proposed contaminant transport modeling for the TAN RI/FS. One of the objectives of the OU 1-07B remedial investigation is to define the southern (S, SW, and SE) and vertical extent of contamination. The contaminant transport model for TAN uses a vertically integrated approach, which takes into account both horizontal contaminant migration and vertical contamination distribution due to dispersion. The TAN-GWCS document reviews in detail the geologic, hydrologic, and computational factors influencing the model selection process, thus summarizing the current understanding of the TAN groundwater flow system. Following that summary, a detailed description of the code selection criteria and results of the application of these criteria to various flow and transport codes are presented. On the basis of the code selection process, recommendations and associated considerations are given. As a result of this process it is (1) recommended that a two-dimensional areal vertically integrated, transient, heterogeneous, free-surface approach be used for this model, (2) suggested that there are no codes in their current form available for this type of flow and transport modeling; and concludes (3) that any code selected will require some modification, and (4) that it would be much more efficient to modify codes developed at EG&G Idaho (i.e. FLASH/FLAME) for this modeling effort as opposed to modifying other available codes.

5.6 RISK ASSESSMENT

A risk assessment will be conducted for the TAN Groundwater RI/FS and will, in addition to the ARARs, provide criteria for developing remediation goals for the contaminated groundwater. The baseline risk assessment (BRA) is comprised of a human health evaluation and an environmental evaluation.

5.6.1 Human Health Evaluation

The goal of the human health evaluation is to provide a framework for developing the risk information necessary to assist in making decisions regarding remedial actions at the site. The evaluation will involve a baseline risk assessment to determine the potential adverse health effects (both current and future) caused by hazardous releases from the contaminant sources (i.e., TSF-05 injection well) under the no-action alternative.

The TAN groundwater BRA will follow guidance provided in the EPA's Risk Assessment Guidance For Superfund, Volume I: Human Health Evaluation Manual (RAGS HHEM) (EPA, 1989a) and Volume II, Environmental Evaluation Manual (EEM) (EPA, 1989b). Supplemental guidance prepared specifically for EPA Region X will also be followed (EPA, 1991).

The scope of this BRA is limited to the evaluation of health risks directly attributable to contaminants currently detected in the TAN groundwater system and the migration of those contaminants through the environment in the future. For the TAN groundwater system, the potentially significant exposure media is the groundwater.

The BRA will consider risks under both current and future land use scenarios. The current land use scenario to be evaluated is the industrial use of groundwater as a potable water source. The specific pathways that will be evaluated under this scenario are ingestion of groundwater and inhalation of volatiles while showering. Dermal contact would be limited to showering under current use and therefore will not be evaluated. The exposure duration for the contaminants of concern under this industrial scenario is 250 day/year. Because specific exposure to contaminated sludge removed during injection well activities will be very limited (minutes to hours) and workers will be wearing PPE, a specific exposure pathway from these activities will not be considered. Although institutional responses (i.e., air sparging system and monthly drinking water analysis) will not be used when performing the current-use risk assessment, the mitigating effects of those responses will be evaluated and addressed in the RI report.

A future residential/agricultural land use scenario will be evaluated after a period of institutional control. The institutional control period is based on the expected length of time for programs at TAN to be operational, plus the time to perform decontamination and decommissioning of the facilities in compliance with 10 CFR 61. The future land use scenario will consist of residential use of the groundwater as a potable water source. The potential exposure pathways that will be evaluated under this future residential use are ingestion of the water and inhalation of volatiles while showering. Dermal contact will be considered for the future use scenario only if the exposure assessment for ingestion and inhalation show an unacceptable risk to potential receptors. A future agricultural land-use scenario may also be evaluated. The secondary exposure media under this scenarios include soil and crops that become contaminated by the application of the contaminated groundwater on the crops and soil. Secondary exposure scenarios will include only a qualitative assessment of the ingestion of crops contaminated by irrigated water and the ingestion of soil contaminated by irrigation waters.

The BRA involves a four-step process consisting of data collection and evaluation, exposure assessment, toxicity assessment, and risk characterization, as described below.

5.6.1.1 Data Collection and Evaluation. This step involves gathering and analyzing site data relevant to the human health evaluation and identifying the contaminants at the site that are the focus of the risk assessment process. Existing data for the TAN groundwater system are presented in Section 2 and the appendices of this work plan. Additional data planned for collection are presented in Sections 4 and 5. The approach for the collection of additional data is presented in Section 5.3 and the Field Sampling Plan. QA/QC measures are presented in the TAN Quality Assurance Project Plan.

The BRA will be evaluated based on the FY-89 and FY-90 data, and if necessary, remedial investigation data. A preliminary list of contaminants of concern and their risk-based concentrations and detection limits is found in Section 4, Table 4-1 of the Work Plan. A screening of this preliminary contaminant list will be made to focus the BRA on important chemicals/radionuclides.

5.6.1.2 Exposure Assessment. An exposure assessment will be conducted to estimate the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways by which humans at or in the vicinity of the TAN groundwater site may be exposed. Exposure estimates will be made for both current and future land-use assumptions. The exposure assessment will involve analyzing contaminant releases, identifying exposed populations, identifying potential pathways of exposure, estimating exposure point concentrations for specific pathways based on environmental monitoring data and fate and transport modeling, and estimating contaminant intakes for specific pathways. The result of the exposure assessment will be the determination of pathway-specific intakes for current and future exposures to individual contaminants.

Potential exposure pathways and potentially exposed human populations have already been identified by way of the preliminary conceptual model for the TAN groundwater system presented in Section 3.2.2. Considerable information on contaminant releases at the site has also been obtained from existing data and the approximate extent of these contaminant releases has been determined from the FY-89 and FY-90 site investigations. This information will be refined if necessary based on the RI tasks.

The exposure assessment will refine the conceptual model presented in Section 3.2.2 and will consider both a current industrial land-use scenario and a future residential/agricultural land-use scenario. Table 5-6 provides detail regarding the contaminated medium, exposure scenario, and potential exposure pathways. The calculation of risks will be for the reasonable maximum exposure as defined in the HHEM. Fate and transport models will be used to determine future concentrations at the source and the TAN facility boundary. Based on the conceptual model in Figure 5-4, groundwater is the potentially significant exposure media. Exposure is then assumed to occur as a result of use of contaminated groundwater for drinking water, irrigation, and other residential uses (i.e., shower). Potential secondary exposure media include crops and soil that become contaminated from irrigational use of the groundwater and will be qualitatively evaluated based on the results of the primary groundwater exposure assessment.

5.6.1.3 Toxicity Assessment. Toxicity assessment summarizes the critical toxicity information for a chemical and is conducted prior to the risk characterization process. Toxicity information together with the exposure assessment results are used to characterize risks. The toxicity information consists of values that describe the degree of toxicity of a chemical.

The primary source of data for reference doses and cancer slope factors will be the Integrated Risk Information System maintained by the EPA. Secondary sources include the Health Effects Assessment Summary Tables (EPA, 1990), the HHEM, Agency for Toxic Substances and Disease Control Toxicological Profiles, EPA water quality criteria documents, and EPA health advisories. For chemicals not listed in EPA guidance, toxicity information is also available through the Environmental Criteria and Assessment Office (ECAO). The ECAO will be contacted if insufficient information exists in EPA's guidance documents or databases.

Table 5-6. TAN groundwater system exposure pathways

Contaminated Medium	Exposure Scenario	Potential Exposure Pathway
Current land-use scenario:		
Ground water	Industrial use as potable water.	Ingestion of water
		Inhalation of volatiles
Future land-use scenario:		
Ground water	Residential use as potable water.	Ingestion of water
		Inhalation of volatiles
		Dermal Contact with water (only if ingestion and inhalation show unacceptable risks)
Secondary Medium:		
Soil	Residential/Agricultural	Soil ingestion
Crops	Residential/Agricultural	Consumption of crops

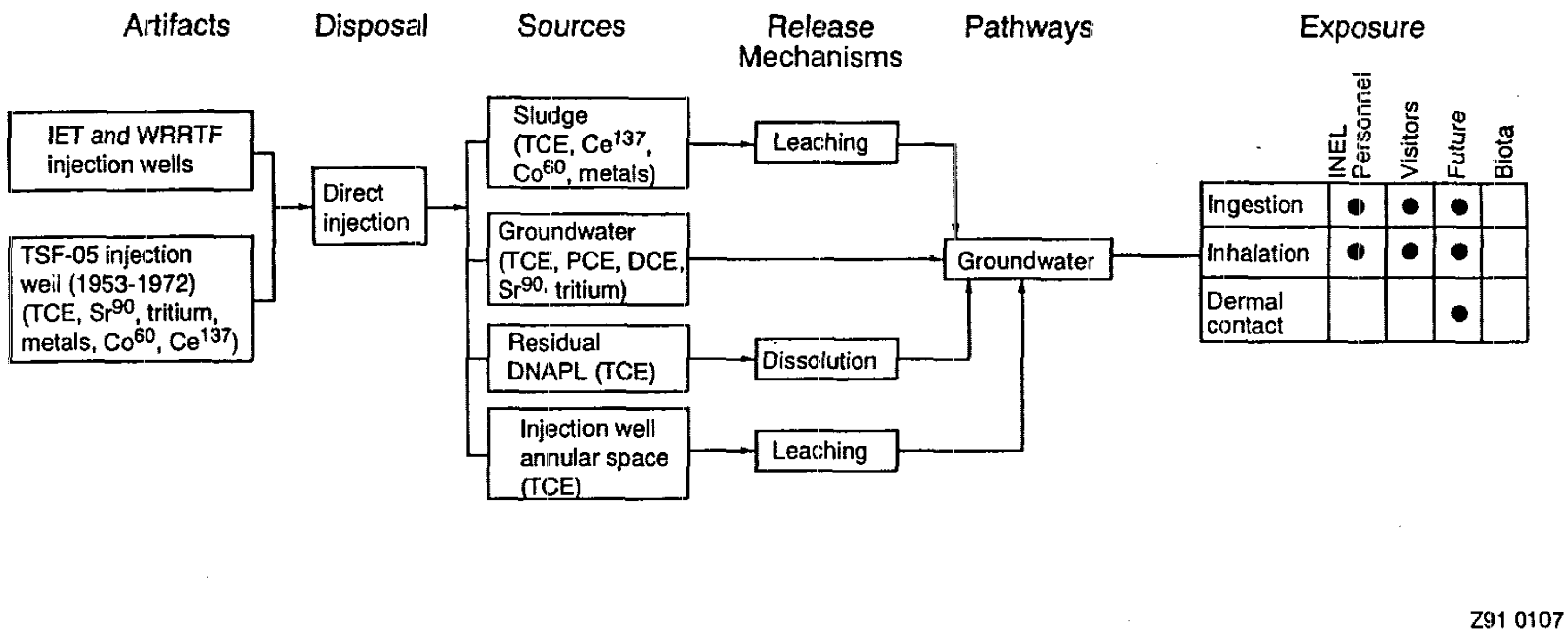

Figure 5-4. Exposure sources, mechanisms, pathways, and receptors applicable to the TAN groundwater system.

5.6.1.4 Risk Characterization. The final step in the overall risk assessment process is to integrate the results of the exposure assessment and the toxicity assessment in an estimate of risk to humans from the site. The risk characterization is concerned with three types or components of risk--(1) *chemical noncarcinogenic*, (2) *chemical carcinogenic*, and (3) *radionuclide* carcinogenic.

To arrive at a single value for each carcinogenic and noncarcinogenic risk present at the site it will be necessary to combine the risks associated with multiple chemicals. In addition, the risks associated with chemicals and radionuclides will also be combined. However, it has been shown that because of the mechanistic differences in the processes of carcinogenicity, it may not be appropriate to simply add the carcinogenic risks associated with chemical and radionuclide exposure (Till, 1988). However, at this time, this seems to be the only practical method of combining the two types of risk.

5.6.2 Environmental Evaluation

As part of the risk assessment process, the impacts of the no-action alternative on the natural environment need to be evaluated. This evaluation, referred to as an ecological risk assessment (ERA), will be a qualitative assessment of the actual or potential effects of the contaminated groundwater at TAN on plants and animals other than people and domesticated species (EPA, 1989b).

The ERA is a qualitative evaluation of the potential ecological effects associated with the TAN groundwater system. The ERA will follow guidance provided in the RAGS Volume II, Environmental Evaluation Manual (EEM) (EPA, 1989b). The ERA will generally follow the same steps used in the human health evaluation described in Section 5.6.1, with minor differences. The ERA will focus on the same contaminants as those evaluated in the human health assessment. The objective of the study is to qualitatively evaluate the potential risk to ecological receptors from the contaminants of concern in the TAN groundwater system. Like the human health assessment, the discussion of impacts is limited to the TAN groundwater as the sole source of contamination.

5.6.3 Uncertainty Analysis in the Risk Assessment Process

The risk assessment process represents an inexact science, whose application is associated with uncertainties and limitations. These inherent uncertainties associated with the risk assessment process will be investigated. This analysis will provide the necessary information to make an informed decision concerning remedy selection to reduce risks at the site.

Many uncertainties exist in the determination of factors related to risk such as toxicity values, cancer incidence rates, and exposure scenarios. Uncertainties will be discussed qualitatively in accordance with the HHEM. Parametric sensitivity analyses will also be conducted to quantitatively illustrate the impacts of the uncertainties on inputs to the models.

5.7 TREATABILITY STUDIES

Treatability studies to support the detailed analysis of selected alternatives may be performed using bench-scale or pilot-scale studies. Some technologies selected for detailed analysis may be proven technologies for treatment of traditional hazardous wastes; therefore, information collected in the RI will be adequate for alternative evaluation of proven technologies without treatability studies. However, treatability studies may be necessary to evaluate alternatives applicable to the mixed waste found in the groundwater at TAN. No treatability studies are currently planned for this RI/FS. However, information from the proposed interim action will be used to the extent possible on the evaluation of alternatives. In the event that treatability studies are necessary, a work plan for studies will be developed in accordance with INEL research standards as well as the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988b).

The primary objectives of treatability studies will be the following:

- Acquiring sufficient data so treatment alternatives can be analyzed during the detailed analysis of alternatives and during remedial design of the selected alternative

- Reducing uncertainty in cost and performance estimates

- Determining the applicability of proven or innovative remedial technologies on mixed wastes.

Data needs will be evaluated based on existing technology data and existing site data. If these data are not adequate to screen or evaluate alternatives, treatability studies may be performed. If data from literature reviews and/or specific site data are adequate, treatability studies will not be undertaken. If treatability studies for the TAN groundwater system are deemed necessary, the following steps may be carried out:

- Prepare a work plan for bench studies or, if necessary, pilot studies
- Perform field sampling, or bench testing, or pilot testing
- Evaluate data from field studies, or bench testing, or pilot testing
- Prepare a brief report documenting the results of the testing.

5.7.1 Bench-Scale Testing

Bench-scale testing commonly uses laboratory tests involving small sample volumes to determine unknown variables. The unknown variables include parameters relating to the selection of either remediation technologies or pilot-scale studies, but may also include information necessary to optimize or to allow further refinement of the bench-scale test. Because they can usually be performed in a relatively short time, bench-scale tests should be used to determine information necessary to the final selection of the remedial action. Bench-scale tests will generally be initiated to determine the following:

- Effectiveness of the treatment alternative on the waste
- Differences in performance between competing manufacturers
- Sizing requirements for pilot-scale studies
- Screening of technologies to be pilot-scale tested
- Sizing of those treatment units that would affect the cost of the technology sufficiently to impact the FS evaluation process
- Compatibility of materials with the waste.

For waste-specific variables, bench-scale tests may be appropriate. However, for innovative technologies relating to site-specific conditions, pilot-scale studies may be more appropriate to determine the required information.

5.7.2 Pilot-Scale Testing

Pilot-scale tests are intended to simulate the conditions that exist in the field. Because pilot-scale tests are designed to more closely simulate actual conditions, much larger treatment units and waste volumes are required. Although efforts will be made to limit the size of the pilot units, it is necessary to maintain a size that allows the appropriate data to be gathered.

Unlike bench-scale tests, the time required to discover the effects of a change in pilot-scale operating parameters is usually large. Therefore, time and budget constraints often limit the applicability of pilot-scale tests.

In addition to the information needed for the bench-scale tests, pilot-scale tests also require the following information:

- Site information that would effect pilot-test requirements
- Waste requirements for testing
- Data requirements for technologies to be tested.

Because pilot-scale tests often require the use of large volumes of waste, care should be taken to prevent further degradation of the site and to ensure safe handling and transport of the waste. Additionally, substantive requirements of permits may be required to comply with specific handling, transport, and discharge requirements.

Before bench-scale or pilot-scale tests can be initiated, information concerning the goals and direction of the tests must be developed. Specifically, the following items need to be gathered or developed:

- Data quality objectives
- Quality assurance
- Residuals management

- Waste sampling plan
- Waste characterization
- Treatment goals
- Department of Energy requirements (i.e., Safety Analysis Report, etc.)
- Data requirements for estimating the cost of the technology being evaluated
- Information needed for procurement of equipment and analytical services.

5.7.3 Application of Results

The purpose of the treatability study is to provide information needed for detailed analysis of alternatives and to allow selection of a remedial action that has a reasonable certainty of achieving the response objectives. The results of bench and pilot tests can be used to ensure that conventional and innovative treatment technologies are evaluated equally. The information generated during the treatability study can also be used in the design of the full-scale system.

5.8 RI Reports

A number of interim reports will be produced as a result of activities proposed in this Work Plan for investigation activities. These reports are intended to facilitate preliminary interpretations of data and timely dissemination of data, and will be informational in nature. These include preliminary interpretations of each of the following investigation tasks:

- Well Installation and Subsurface Sampling Interim report
- Groundwater Sampling Interim report.

The activities proposed in this Work Plan will be summarized in an RI report that will serve as a decisional document for deciding if additional RI work is necessary (e.g. in a future phase), or if the data are sufficient to support the evaluation of the remedial alternatives. The proposed outline for this document is presented in Table 5-7.

Table 5-7. TAN Groundwater Operable Unit RI report outline

EXECUTIVE SUMMARY

ACRONYMS AND ABBREVIATIONS

1. INTRODUCTION

    1.1 Federal Facility Agreement and Consent Order

    1.2 Purpose and Scope

    1.3 Site Background

        1.3.1 Site Description
        1.3.2 Site History
        1.3.3 Previous Investigations

2. STUDY AREA INVESTIGATION

    2.1 Surface Features

    2.2 Contaminant Source Investigations

    2.3 Meteorological Investigations

    2.4 Surface Water and Sediment Investigations

    2.5 Geological Investigations

    2.6 Soil and Vadose Zone Investigations

    2.7 Groundwater Investigations

    2.8 Ecological Investigations

3. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

    3.1 Surface Features

    3.2 Meteorology

    3.3 Surface Water Hydrology

    3.4 Geology

    3.5 Soils

    3.6 Hydrogeology

    3.7 Ecology

Table 5-7. (continued)

4. NATURE AND EXTENT OF CONTAMINATION

    4.1 Sources

    4.2 Soils and Vadose Zone

    4.3 Groundwater

    4.4 Surface Water and Sediments

    4.5 Air

5. CONTAMINANT FATE AND TRANSPORT

    5.1 Potential Routes of Migration

    5.2 Contaminant Persistence

    5.3 Contaminant Migration

6. BASELINE RISK ASSESSMENT

    6.1 Human Health Evaluation

        6.1.1 Exposure Assessment
        6.1.2 Toxicity Assessment
        6.1.3 Risk Characterization

    6.2 Ecological Evaluation

        6.2.1 Exposure Routes to Biota
        6.2.2 Survey of Plants and Biota
        6.2.3 Ecological Risk Assessment

7. PRELIMINARY REMEDIAL ACTION OBJECTIVES AND DATA QUALITY

    7.1 Preliminary Remedial Action Objectives

    7.2 Data Limitations/Uncertainty

ATTACHMENTS

A. REFERENCES

B. ADDENDUMS

5.9 FEASIBILITY STUDY

The feasibility study (FS) for the TAN Groundwater R/FS will be conducted in two phases. The first phase (discussed in this section) involves the development and screening of remedial alternatives, and includes development of remedial action objectives and general response actions. After the range of technologies and process options have been screened, a group of alternatives will be developed that represent distinct, viable approaches to addressing contamination of the groundwater system at TAN. This detailed analysis (phase II) is discussed in Section 5.10.

5.9.1 Development and Screening of Alternatives

Preliminary scoping and the development of a conceptual model have been completed and are described in Sections 3 and 4. An array of characterization information exists for the groundwater system as discussed in Section 2. Some of this information can be used for both risk assessment and the engineering FS tasks required in developing alternatives. The characterization data have been collected over many years and can also provide a basis for defining remedial action objectives and identifying which treatment technologies will be evaluated.

Phase 1 of the FS involves the identification and screening of alternatives for site remediation, which is accomplished by assembling combinations of technologies and the media (soil, groundwater, air, etc.). Alternatives are then developed that address remediation on a site-wide basis, as well as protection of human health and the environment.

5.9.1.1 Remedial Action Objectives. Remedial action objectives identify specific contaminants, media of interest, exposure pathways, and preliminary remediation goals used to develop a range of treatment and containment alternatives needed to protect human health and the environment. At TAN, the contaminants of concern have been identified (see Table 4-1) as TCE, PCE, 1,1-DCE, mercury, tritium, lead, and strontium. The media of interest for the TAN RI/FS is essentially limited to groundwater with ingestion and inhalation as the primary exposure pathways. Remediation goals will be developed on the basis of the remedial action objectives, and chemical-specific or site-specific ARARs and the results of the baseline risk assessment. As part of this analysis, the baseline risk assessment methodology presented in Section 5.6 will be used to model potential chemical-specific risks. The final acceptable exposure levels will be determined on the basis of the risk assessment and the evaluation of the expected exposures and associated risks for each alternative. This type of analysis will address each significant exposure pathway providing a basis for refining the remedial action objectives. Protectiveness may also be achieved by reducing exposure or by reducing contaminant levels. Exposure may be reduced through actions such as the TSF-05 interim action, limiting access, or providing an alternate water supply.

5.9.1.2 General Response Actions. General response actions describe those actions that satisfy the remedial action objectives. Response actions may include remedial actions such as in-situ treatment, interim actions, institutional controls such as the air sparging system already in place at TAN, no action, or a combination of these.

The general response actions will be refined throughout the FS process as site conditions become better understood and action-specific ARARs are identified. Response actions for each area or volume of media will be refined after the TAN RI. Examples of general response actions for TAN groundwater might include

- No action
- Institutional actions, which include (a) access restrictions, (b) alternative water supply, (c) air sparging, and (d) monitoring
- Collection/treatment actions, which include (a) groundwater extraction followed by treatment and (b) in-situ treatment.

5.9.1.3 Identify Volumes or Areas of Media. During the development of alternatives, an initial determination will be made of areas or volumes of media to which general response actions might be applied. For the TAN groundwater system, the results of RI activities will be used to estimate the volume of contaminated groundwater. Both the vertical extent of contamination and the influence of the sedimentary interbeds on contaminant distribution and movement will factor into this estimate.

5.9.1.4 Identify and Screen Remedial Technologies and Process Options. In this step, an inventory of remedial technologies will be developed that are appropriate to each general response action. Remedial alternatives for groundwater systems such as the Snake River Plain Aquifer are fairly limited [i.e. no action, groundwater extraction, in-situ treatment (bioremediation etc.)]. However, other potentially applicable alternations will be identified and screened using existing industrial waste treatment technologies, current DOE site restoration programs, and EPA documentation/data bases developed through experience at Superfund sites. Examples of data bases that will be used include Technical Information Exchange (TIX), Alternative Treatment Technology Information Center (ATTIC), and Cost of Remedial Actions (CORA). An EG&G Idaho data base that addresses remediation technologies applicable to the RWMC is under development. Information in this data base will also be considered.

5.9.1.5 Evaluation of Process Options. This step will involve the evaluation of process options, which are defined as specific applications within each technology type that are compatible with the remedial action objectives. In the Proposed Plan for the TSF-05 injection well (an addendum to this Work Plan), three process options compatible with a groundwater extraction technology have been identified and evaluated. The three options include (1) treatment by air stripping, ion exchange, and carbon adsorption, (2) treatment by carbon adsorption and ion exchange, and (3) treatment by chemical destruction and ion exchange. While these process options would also be compatible with a groundwater extraction alternative for TAN OU 1-107B, other process options considered feasible will be evaluated before selecting one process to represent each technology type. Selection of one representative process will simplify subsequent development and evaluation of alternatives without limiting flexibility during remedial design because other viable options will not be ruled out at this stage of the assessment. The representative process selected will provide a basis for developing performance objective/specifications during preliminary design. However, the final process selected may differ if the overall screening criteria discussed below suggest the use of an alternative process option within a given technology type. In some cases, more than one process option may be selected.

Criteria used at this stage in the FS to screen process options are effectiveness, implementability, and cost. The effectiveness evaluation will focus on the following:

- The potential for each process option to handle the estimated areas or volumes of media concerned, while meeting goals identified in the remedial action objectives
- The potential impacts to human health and the environment during the construction and implementation stage
- How proven and reliable the process is with respect to the contaminants and conditions at the site.

Reliability is a criterion based on past experience with individual process options. While this is an important factor, it will not limit consideration of innovative or emerging technologies. Lack of experience in remediation of mixed wastes will necessitate evaluation of new remediation approaches. This is directly compatible with the mission of the INEL to conduct leading edge research and development in the field of environmental restoration.

Implementability encompasses the technical and administrative aspects of process option feasibility. Evaluations at this stage focus on institutional aspects of implementability, such as the ability to comply with the substantive requirements of necessary permits; the availability of treatment, storage, and disposal services; and the availability of necessary equipment and skilled workers to implement the technology.

Cost plays a limited role in screening process options at this stage. Relative capital and operation and maintenance data are used rather than detailed estimates of process options costs.

5.9.1.6 Assemble Alternatives. Preliminary remedial alternatives will be developed by assembling general response actions and the process options chosen to represent each technology type for each contaminated environmental medium. An example of this is the groundwater extraction technology and three process options identified in the Proposed Plan for the TSF-05 injection well Interim Action. Alternatives will be assembled using different technology types and different volumes of media or areas of the site. Those alternatives will then be analyzed under a general response action such as no action, limited action, source containment with no groundwater controls, institutional responses and so on. A description of each alternative that is analyzed will be included in the FS report. Included with the description will be the logic behind the assembly of the general response actions and the process options that were not selected.

5.9.2 Screening of Alternatives

5.9.2.1 Alternatives Screening Process. Before a detailed analysis of alternatives is undertaken, alternative screening will be performed concurrently with developing alternatives. As mentioned earlier, practical alternatives for a groundwater system such as that found at TAN are limited. However, screening of potential alternatives will still be carried out.

The endpoint of alternative screening will be the finalization of a set of alternatives for detailed evaluation. Considerations during screening may include the extent of remediation required, operational considerations of process options, interphase relationships, and others.

Screening will be typically performed in the three steps listed below.

1) Refinement

This step will include defining specific performance parameters of alternatives, including time required for remediation, remedial technology capacities and capabilities, and others. During definition, the expected performance of specific alternatives may be compared to risk-based remediation objectives. Definition will be performed such that alternatives may be compared with respect to effectiveness, implementability, and cost. During refinement, it is also important that site-specific considerations such as volumes of media and interphase effects between contaminated media be considered.

Conceptual design of alternatives may proceed during refinement of alternatives. Parameters to be addressed may include:

- Alternative capabilities (e.g., processing rates and removal efficiencies vs. site-specific media volume and contaminant concentration data)
- Estimated remediation time vs. objectives
- Treated media disposal requirements
- Compliance with the substantive requirements of permitting.

2) Screening Evaluation

With respect to effectiveness, implementability, and cost, the objective of the screening evaluation will be to reduce the number of alternatives evaluated during the detailed analysis of alternatives. Therefore, the screening analysis will be less rigorous than that performed during the detailed analysis. However, it will be sufficiently detailed to allow for comparison between alternatives.

Relatively few technologies have been applied to potentially radiologically contaminated site remediation. Therefore, screening of alternatives for the TAN groundwater system is likely to involve consideration of innovative technologies. Innovative technologies may be carried through development and screening if there is a reasonable belief the technology may offer significant advantages. If necessary, treatability studies required to evaluate the site-specific performance of an innovative technology will be planned as early as practical.

Effectiveness (the most important screening criterion) may be defined as the degree to which the alternative meets the requirement for protection of human health and the environment. Short- and long-term effectiveness will be evaluated. Implementability (both technical and administrative) is used for site-specific process evaluation. Cost will be defined as accurately as possible, using vendor quotes, EPA publications, and other sources. Estimates made during screening will, of necessity, be less accurate than those made during the detailed analysis of alternatives. Administrative costs, and others that are applicable to all alternatives, will be considered in less detail than process-specific capital, operating and maintenance costs. Present-worth analysis will be used to determine the life-cycle cost of each alternative.

3) Decision (as to which alternatives are to be retained for detailed analysis)

During this step, the lead agency (DOE) and its contractor will meet with the support agencies (the EPA and the State of Idaho) and discuss the alternatives under consideration. The purpose of this meeting will be to provide the lead agency and its contractor with guidance and comment from the support agencies and to inform the support agencies of the current direction of the FS. At this meeting, the alternatives retained for detailed analysis will be agreed upon. Alternatives eliminated during screening may be reconsidered during detailed analysis if new information becomes available.

5.9.2.2 Post-Screening. Post-screening tasks will be performed to expedite the transition from screening to detailed analysis. Tasks may include identification of action-specific ARARs, additional treatability studies, and additional site characterizations.

Action-specific ARARs will be defined as alternatives become more clearly defined. After screening is complete, process options and alternatives will be defined with a sufficient level of detail so the lead agency can discuss action-specific ARARs with the support agencies.

5.9.2.3 Community Relations During Screening of Alternatives. Public interest may increase during screening of alternatives; therefore, community relations activities will be planned and performed as stipulated in the Community Relations Plan (see attached addendum). Activities may include briefing of public officials, interest groups, and citizens. The goals of community relations during screening of alternatives may include

- Informing the community of the agency's decision-making process
- Educating the public on important issues in screening and selecting alternatives

- Soliciting responses from the community.

5.9.2.4 Reporting and Communication During Alternative Screening. Coordination between the lead and support agencies is critical during alternative screening. The following activities are of particular importance.

- The lead and support agencies will reach agreement on the final list of alternatives to be retained for detailed analysis
- The lead and support agencies must coordinate the identification of action-specific ARARs
- The lead agency and its contractor will evaluate the need for additional data requirements or site characterization required to perform the detailed analysis of alternatives.

The results of coordination activities will be documented. Methods of reporting coordination activities may include letters, technical memos, etc.

Documentation of all steps in alternative screening will include

- Chemical- and/or risk-based remedial objectives
- Multiple-pathway exposure and interphase interactions consideration
- Alternative definition, including extent of remediation required, volume(s) of contaminated media, process efficiency and operational considerations, remediation time required to reach objectives, and others
- Screening evaluation summaries for each alternative
- Screening evaluation summaries between alternatives
- QC summary of work efforts.

5.10 ALTERNATIVE ANALYSIS

Alternatives that passed the screening step will be analyzed and evaluated in detail in Phase II of the FS. This evaluation will assess a group of alternatives that show the greatest potential for remediation of the TAN site and that satisfy the remedial action objectives. A detailed analysis of each alternative will be performed to provide the supporting documentation for selecting the preferred alternative(s) and to prepare and finalize a ROD.

5.10.1 Analysis Criteria

The analysis criteria will be used to address the CERCLA requirements and considerations with EPA guidance (EPA, 1988b) as well as additional technical and policy considerations. These analysis criteria will serve as the basis for conducting the detailed analysis and subsequently for selecting a preferred remedial action. There are nine criteria that can be categorized into three groups, each with distinct functions in selecting the remedy (53 FR 51394). These criteria are listed below.

- Threshold criteria, which include overall protection of human health and the environment and compliance with ARARs
- Primary Balancing Criteria, which include (a) long-term effectiveness and permanence, (b) reduction of mobility, toxicity, or volume through treatment, (c) short-term effectiveness, (d) implementability, and (e) cost
- Modifying criteria, which include state and community acceptance.

Overall protection criteria evaluate how the alternative, as a whole, protects and maintains protection of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs assesses how each alternative complies with ARARs, criteria, advisories, or other guidelines. Waivers will be identified if necessary. The following factors will be addressed for each alternative during the detailed analysis of ARARs:

- Compliance with chemical-specific ARARs
- Compliance with action-specific ARARs
- Compliance with location-specific ARARs
- Compliance with appropriate criteria, advisories, and guidelines.

Long-term effectiveness and permanence evaluates the alternative's effectiveness in protecting human health and the environment after response objectives have been met. The following components of the criteria will be addressed for each alternative:

- Magnitude of remaining risk
- Adequacy of controls
- Reliability of controls.

The reduction of toxicity, mobility, or volume through treatment assessment evaluates anticipated performance of the specific treatment technologies. This evaluation will focus on the following specific factors for a particular remedial alternative:

- The treatment process, the remedies employed, and the materials treated

- The amount of hazardous materials that will be destroyed or treated, including how principal threats will be addressed

- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude)

- The degree to which the treatment will be irreversible

- The type and quantity of treatment residuals that will remain following treatment.

Short-term effectiveness evaluates an alternative's effectiveness in protecting human health and the environment during the construction and implementation period until the response objectives are met. Factors that will be considered include

- Protection of community during remedial actions
- Protection of workers during remedial actions
- Environmental impacts
- Time until remedial response objectives are achieved.

Implementability evaluates the technical and administrative feasibility of alternatives and the availability of required resources. Analysis will include the following factors and subfactors.

Technical feasibility:

- Construction and operation
- Reliability of technology

- Ease of undertaking additional remedial action
- Monitoring considerations.

Administrative feasibility:

- Land ban restrictions
- Need for institutional controls
- Compliance with substantive requirements of permitting.

Availability of services and materials:

- Availability of adequate offsite treatment, storage capacity, and disposal service

- Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources

- Timing of the availability of technologies under considerations

- Availability of services and materials.

The cost assessment evaluates the capital and operation and maintenance costs of each alternative. A present-worth analysis based on a 4% inflation rate, and a maximum design life of up to 30 years will be used to normalize remedial action alternatives. A smaller time frame will be used for alternatives for which shorter times for remedial action can be substantiated. Also to be included will be an uncertainty (accuracy of cost estimates) analysis and a sensitivity analysis. Cost estimates for each alternative will consider the following factors.

Capital costs:

- Construction costs
- Equipment costs
- Land and site development costs
- Building and services costs
- Relocation expenses
- Disposal costs
- Engineering expenses
- Legal fees, license, and permit costs
- Startup and troubleshooting costs
- Contingency allowances.

Annual Costs:

- Operating labor
- Maintenance materials and labor
- Auxiliary materials and energy
- Disposal of residues.

Availability of services and materials:

- Purchased services (i.e., sampling costs, laboratory fees, and professional fees)
- Administrative costs
- Insurance, taxes, and licensing
- Maintenance reserve and contingency funds
- Rehabilitation costs
- Costs of periodic site reviews.

State acceptance will evaluate the technical and administrative issues and concerns the State may have regarding each of the alternatives. State acceptance will also focus on legal issues and compliance with State statutes and regulations. Community acceptance will incorporate public concerns into the analyses of the alternatives.

5.10.2 Detailed Analysis of Alternatives

Alternatives that pass the Phase I screening step will be analyzed in detail and evaluated against the criteria discussed above during Phase II. The result of this detailed evaluation will be a group of alternatives that show the greatest potential for remediation and satisfy the remedial action objectives. A detailed analysis of each alternative will be performed to provide the supporting documentation for the selection of the preferred alternatives. Additional treatability studies, field data, or models necessary to conduct or complete the detailed analysis of alternatives may be identified during this phase.

The final step in Phase II will be to conduct a comparative analysis of the alternatives. The analysis will include a narrative discussion of the alternative's relative strengths and weaknesses with respect to each criterion, and how reasonable variations of key uncertainties could change the expectations of their relative performance. Innovative technologies will be compared to demonstrated technologies, evaluating the potential advantages in cost or performance and the degree of uncertainty in the expected performance.

5.11 FEASIBILITY STUDY REPORT

A draft FS report will be prepared at the completion of the FS, which documents the analysis process described in Sections 5.9 and 5.10. The draft report will contain the following elements:

- Objectives of remedial response
- Actions of general response
- Analysis of ARARs
- Description of potential remedial technologies and development of alternatives
- Description of screening methodology
- Results of screening evaluations
- Description of the detailed alternative evaluation process
- Results of the detailed alternative analysis
- Summary and comparison of alternatives.

The analysis of individual alternatives will include information on

- Assumptions made during the analysis
- Implementation requirements
- Compliance with ARARs
- Risk-based exposure scenarios for alternatives
- Quantities of material to be treated
- Concentrations of constituents to be treated per unit volume
- Time requirements
- Sizing requirements
- Cost.

The analysis of individual alternatives with respect to the methodology presented in Section 5.10 will be presented in a tabular format combined with a narrative discussion. A proposed format for the feasibility study report is presented in Table 5-8.

Information on environmental impacts will be prepared as necessary to supplement the information contained in the RI/FS report. At this time, the results of the TAN groundwater RI/FS are expected to create no significant adverse impact to the environment. However, if at anytime during the development of the RI/FS it is determined that the remedial alternatives being considered have significant environmental impacts, additional information will be added to the RI/FS as necessary to comply with DOE environmental impact requirements.

5.12 PROPOSED PLAN AND RECORD OF DECISION

The RI/FS process culminates with the Proposed Plan and the ROD. The Proposed Plan would be a summary of the information in the RI/FS Report on the remedial alternatives that were evaluated. The Proposed Plan would describe the preferred alternative selected by the DOE, the EPA, and the Idaho Department of Health and Welfare (IDHW) for the TAN groundwater remedial action, so that the plan can be sent out for public review. Public comments would be considered by the DOE, the EPA, and the IDHW before selection of the actual final remedy, and the official response to the public comments and a detailed description of the selected alternative would be given in the Record of Decision. Other public relations activities are detailed in the site-specific RI/FS Community Relations Plan attached as an addendum to this Work Plan.

At the INEL, draft RODs will be prepared for signature by the DOE, the EPA, and the IDHW. Following finalization of the ROD, the DOE will initiate remedial design, remedial action, monitoring during remedial actions as required, and post-remedial action operations and maintenance (if the selected remedy requires operations and maintenance) in accordance with the FFA/CO.

Table 5-8. FS report format

1. INTRODUCTION

    1.1 Purpose and Organization

    1.2 Background Information

        1.2.1 Site Description
        1.2.2 Site History
        1.2.3 Nature and Extent of Contamination
        1.2.4 Contaminant Fate and Transport
        1.2.5 Baseline Risk Assessment

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

    2.1 Introduction

    2.2 Remedial Action Objectives

    2.3 General Response Actions

    2.4 Identification and Screening of Technology Types and Process Options

3. DEVELOPMENT AND SCREENING OF ALTERNATIVES

    3.1 Development of Alternatives

    3.2 Screening of Alternatives

        3.2.1 Alternative 1
        3.2.2 Alternative 2
        3.2.3 Alternative x^n

4. DETAILED ANALYSIS OF ALTERNATIVES

    4.1 Introduction

    4.2 Individual Analysis of Alternatives

        4.2.1 Alternative 1
            4.2.1.1 Description
            4.2.1.2 Assessment
        4.2.2 Alternative 2
            4.2.2.1 Description
            4.2.2.2 Assessment

    4.3 Comparative Analysis of Alternatives

ATTACHMENTS

A. REFERENCES
B. ADDENDUMS

6. Schedule

Number

6. SCHEDULE

The original detailed working schedule for the remedial investigation/ feasibility study (RI/FS) activities at the Test Area North (TAN) Groundwater Operable Unit, as documented in Attachment H of the RI/FS Scope of Work, is shown in Figure 6-1. This detailed working schedule does not include tasks associated with the Interim Action, which is being run concurrently with RI/FS Work Plan tasks.

The original summary working schedule in Table 1 of the RI/FS Scope of Work did not account for the second round of well sampling now scheduled for October 1992. To allow sufficient time to analyze and evaluate the data from the extra round of sampling, the original table in the RI/FS Scope of Work has been modified to match the detailed schedule in Attachment H of the RI/FS Scope of Work. All the original enforceable deadlines will still be met. The Record of Decision will now be signed in September 1994 instead of August 1994. The modified summary working schedule with the key action plan dates is given in Table 6-1.

Time Now : 1-Jul-91
Project : OU 1-07 RI/FS SCHEDULE
Output : Gantt Report
Sheet : 1 of 2

WAG 1

J. R. ZIMMERLE

	Duration	Start	Finish
Statement of Work/Scop.	1,4	1-Jul-91	12-Jul-91
HAMMOCK FOR RI/FS SCOPING OU1-07	38,0	1-Jul-91	2-Apr-92
EG&G Review--SOW/Scop.	1,0	15-Jul-91	19-Jul-91
Legal Review--SOW/Scop.	1,0	15-Jul-91	19-Jul-91
DOE Review--SOW/Scop.	1,0	22-Jul-91	26-Jul-91
Finalize Draft SOW/Scop	0,3	29-Jul-91	31-Jul-91
Work Plan/Scop.	10,0	30-Jul-91	8-Oct-91
Prel. Conceptual Site Model/Scop.	10,0	30-Jul-91	8-Oct-91
Field Sampling Plan/Scop.	10,0	30-Jul-91	8-Oct-91
Draft SOW Submitted to EPA/IDHW/Scop.	0,0		31-Jul-91
EPA/IDHW Review--SOW/Scop.	6,0	1-Aug-91	12-Sep-91
Health & Safety Plan/Scop.	8,0	13-Aug-91	8-Oct-91
Comm. Relations Plan/Scop.	8,0	13-Aug-91	8-Oct-91
Data Management Plan/Scop.	6,0	27-Aug-91	8-Oct-91
QA Project Plan/Scop.	6,0	27-Aug-91	8-Oct-91
Incorporate RFI Data into Summary Report	8,0	4-Sep-91	29-Oct-91
Incorporate Comments--SOW/Scop.	1,4	13-Sep-91	25-Sep-91
DOE Review--SOW/Scop.	2,0	26-Sep-91	9-Oct-91
Prepare NOI/ADM/Scop.	2,0	2-Oct-91	15-Oct-91
Prepare HAZ Classification/Scop.	3,0	2-Oct-91	22-Oct-91
Prepare CX/Scop.	4,0	2-Oct-91	29-Oct-91
Tech. Editing/WP--Work Plan/Scop.	2,0	9-Oct-91	22-Oct-91
Finalize SOW/Scop.	1,0	10-Oct-91	16-Oct-91
Submit NOI/ADM to DOE	0,0		15-Oct-91
DOE Review NOI/Scop.	2,0	16-Oct-91	29-Oct-91
DOE Review of ADM/Scop	20,0	16-Oct-91	12-Mar-92
Final Statement of Work Approval/Scop.	4,0	17-Oct-91	14-Nov-91

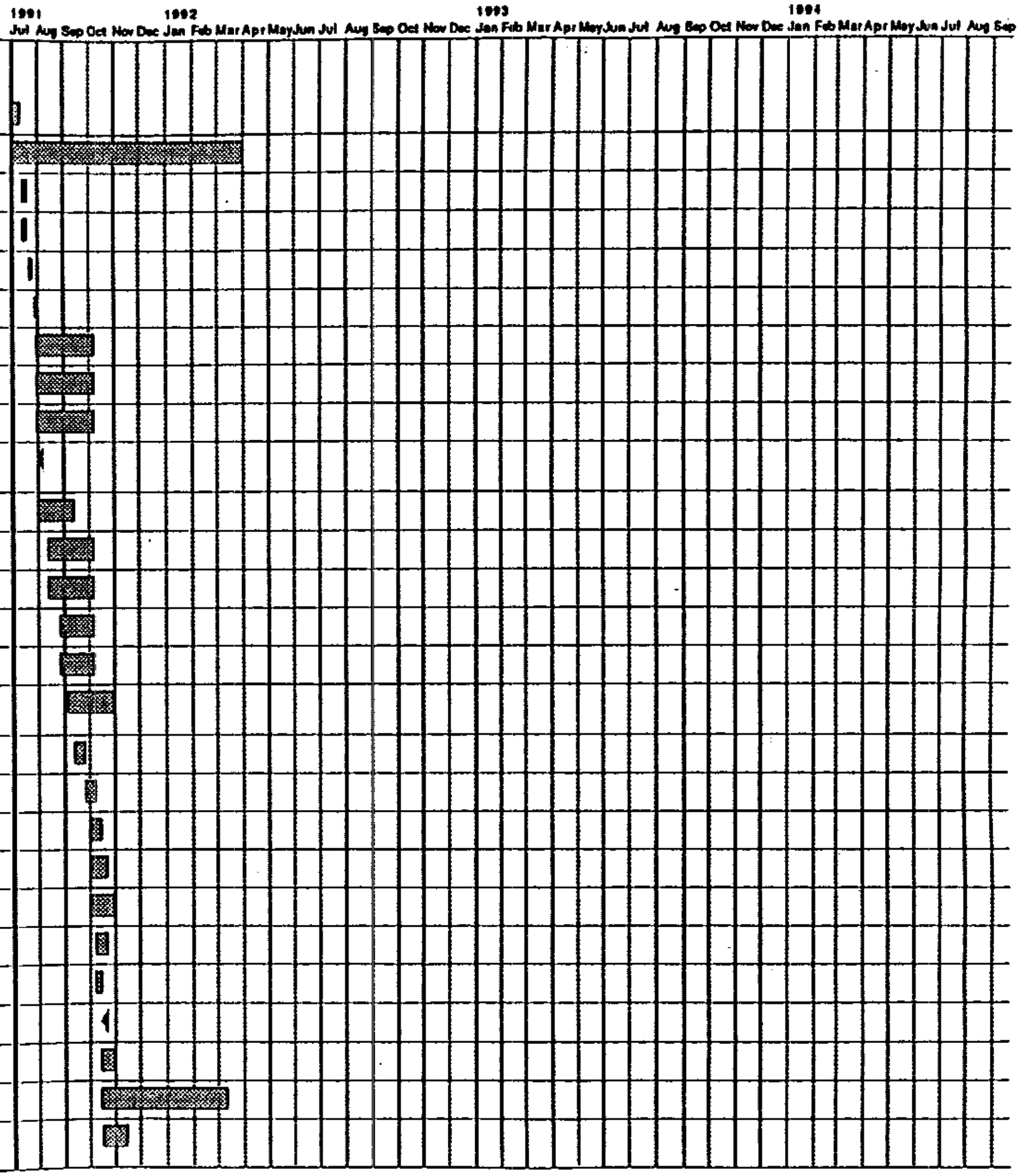

Figure 6-1. CERCLA response schedule for the TAN Groundwater Operable Unit at the INEL.

Date : 19-Oct-91
Time Now : 1-Jul-91
Project : OU 1-07 RI/FS SCHEDULE
Output : Gantt Report
Sheet : 2 of 2

WAG 1

J. R. ZIMMERLE

	Duration	Start	Finish
Submit Hazard Classification to DOE	0.0		22-Oct-91
EG&G Review--WP/Scop.	2.0	23-Oct-91	5-Nov-91
Legal Review--WP/Scop.	2.0	23-Oct-91	5-Nov-91
DOE Review Haz Class/Scop	4.0	23-Oct-91	20-Nov-91
Submit CX to DOE	0.0		29-Oct-91
Publish NOI/Scop.	1.0	30-Oct-91	5-Nov-91
DOE Review-CX/Scop.	20.0	30-Oct-91	26-Mar-92
DOE Review--WP/Scop.	4.0	6-Nov-91	6-Dec-91
DOE Approves Haz Class	0.0		20-Nov-91
Incorporate Comments/Scop.	2.0	9-Dec-91	20-Dec-91
Final SOW Approved/Scop.	0.0		23-Dec-91
Submit Draft Workplan to EPA/IDHW/Sco	0.0	23-Dec-91	
Interface with Implementation Phase to Start Planning for Spring Drilling/Sampling Effort			23-Dec-91
EPA/IDHW Review--WP/Scop.	6.0	23-Dec-91	5-Feb-92
Revision--WP/Scop.	2.0	6-Feb-92	20-Feb-92
DOE Review Final WP/Scop.	1.0	21-Feb-92	27-Feb-92
WP Goes Final/Scop.	1.0	28-Feb-92	5-Mar-92
Workplan Approval/Scop.	4.0	6-Mar-92	2-Apr-92
DOE Approves ADM/Scop	0.0		12-Mar-92
DOE Approves CX	0.0		26-Mar-92
Final Workplan Approved/Scop.	0.0		2-Apr-92

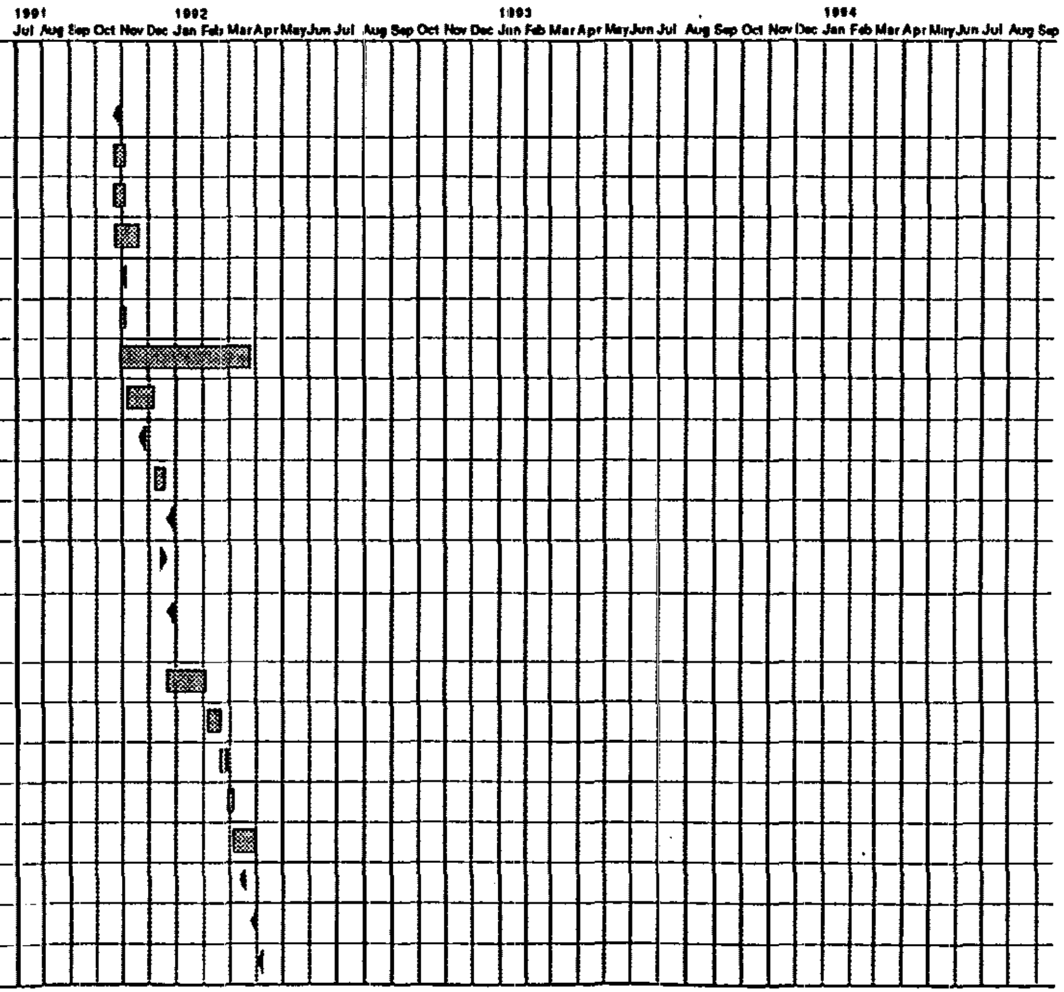

Figure 6-1. (continued)

Time Now : 1-Jul-91
Project : OU 1-07 RI/FS SCHEDULE
Output : Gantt Report
Sheet : 1 of 4

WAG 1

	Duration	Start	Finish
J. R. ZIMMERLE			
Start Monthly Water Level Measurements/Imp		1-Oct-91	
Prepare Contour Map/Water Budget/Imp	12,0	1-Oct-91	30-Dec-91
Gather/Evaluate Data on Water Levels/Imp	70,0	1-Oct-91	24-Feb-93
Interface with Draft Workplan		2-Jan-92	
Start Hose Removal from Well/Imp		2-Jan-92	
Prepare Drilling SOW	3,0	2-Jan-92	22-Jan-92
Prepare Response to USQ Evaluation on Treatment Plant SAP/Imp	4,0	2-Jan-92	29-Jan-92
Prepare Hose Removal Procedure/Imp	5,0	2-Jan-92	5-Feb-92
Award Drilling Subcontract	4,0	23-Jan-92	20-Feb-92
Update SAP/Scop	4,0	30-Jan-92	27-Feb-92
ISRC Review/Imp	4,0	30-Jan-92	27-Feb-92
EIRC Review/Imp	4,0	6-Feb-92	5-Mar-92
Field Mobilization	4,0	21-Feb-92	19-Mar-92
Submit SAP to DOE	0,0		27-Feb-92
Submit USQ Response to DOE for Information/Imp	0,0		27-Feb-92
DOE Review of SAP/Scop	2,0	28-Feb-92	12-Mar-92
Prepare Lab SOW/Scop	3,0	28-Feb-92	19-Mar-92
Schedule Hose Removal/Imp	3,0	6-Mar-92	26-Mar-92
DOE Approves SAP/Submits to Regulators/Scop	0,0		12-Mar-92
Award SOW/Scop	8,0	20-Mar-92	14-May-92
Drilling/Imp. - Drill 3 Well Pairs and Convert the GIN Wells	16,0	20-Mar-92	13-Jul-92
Statement of Work for BOA WAG 1 OU1-07/Imp.	2,0	3-Apr-92	16-Apr-92
HAMMOCK FOR RI/FS IMP, OU1-07	85,0	3-Apr-92	10-Dec-93
Mobilize BOA/Imp.	1,0	17-Apr-92	23-Apr-92
Prepare exposure assessment tech memo	4,0	24-Apr-92	21-May-92

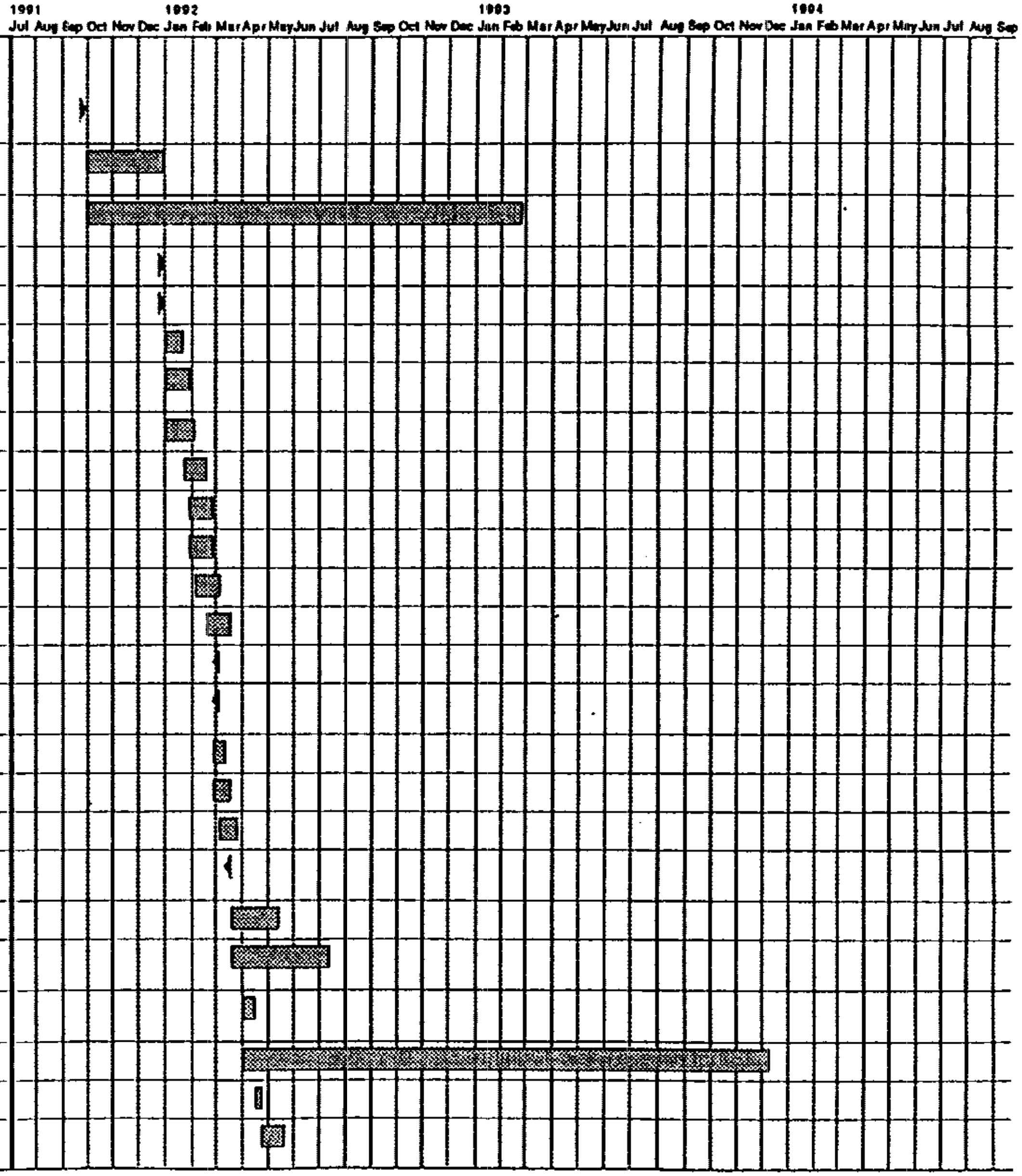

Figure 6-1. (continued)

WAG 1

	Duration	Start	Finish
J. R. ZIMMERLE			
Existing Data Collection/Imp.	16.0	24-Apr-92	17-Aug-92
Develop Fate & Trans. Model/Imp.	28.0	24-Apr-92	11-Nov-92
Identify Site-Specific ARAR's/Imp.	8.0	8-May-92	6-Jul-92
Schedule Sampling	3.0	15-May-92	5-Jun-92
Submit Exposure Memo	0.0		21-May-92
Perform Risk Assessment/Imp.	18.0	22-May-92	29-Sep-92
Remove Hose/Imp	2.0	29-Jun-92	13-Jul-92
Add Scoping Req'ts to the RI Report	8.0	7-Jul-92	31-Aug-92
Water and Cutting Disposal/Imp.	4.0	14-Jul-92	10-Aug-92
Sample Wells/Scop	5.0	14-Jul-92	17-Aug-92
Sample/Water Disposal	6.0	14-Jul-92	24-Aug-92
Analyze Results/Scop	8.0	18-Aug-92	13-Oct-92
Validate Data/Scop	6.0	23-Sep-92	3-Nov-92
Prepare Baseline Risk Assessment Tech Memo	4.0	30-Sep-92	27-Oct-92
Submit Validated Data to EPA/IDHW/Scop	3.0	4-Nov-92	27-Nov-92
Conduct Second Round of Sampling	6.0	4-Nov-92	18-Dec-92
Sample/Water Disposal - Round 2	8.0	4-Nov-92	6-Jan-93
Submit Baseline Memo	0.0		11-Nov-92
Sample Analysis - Round 2/Imp.	8.0	21-Dec-92	18-Feb-93
Remedial Alternatives Development/Imp.	2.0	28-Jan-93	10-Feb-93
Data Validation - Round 2/Imp.	6.0	28-Jan-93	11-Mar-93
Draft RI Report/Imp.	10.0	28-Jan-93	8-Apr-93
Detailed Anal. of Alt./Imp.	12.0	11-Feb-93	6-May-93
Submit Validated Data to EPA - Round 2/Imp.	3.0	12-Mar-93	1-Apr-93
Tech. Ed/WP--RI/Imp.	2.0	9-Apr-93	22-Apr-93
EG&G Review--RI Report/Imp.	3.0	9-Apr-93	29-Apr-93

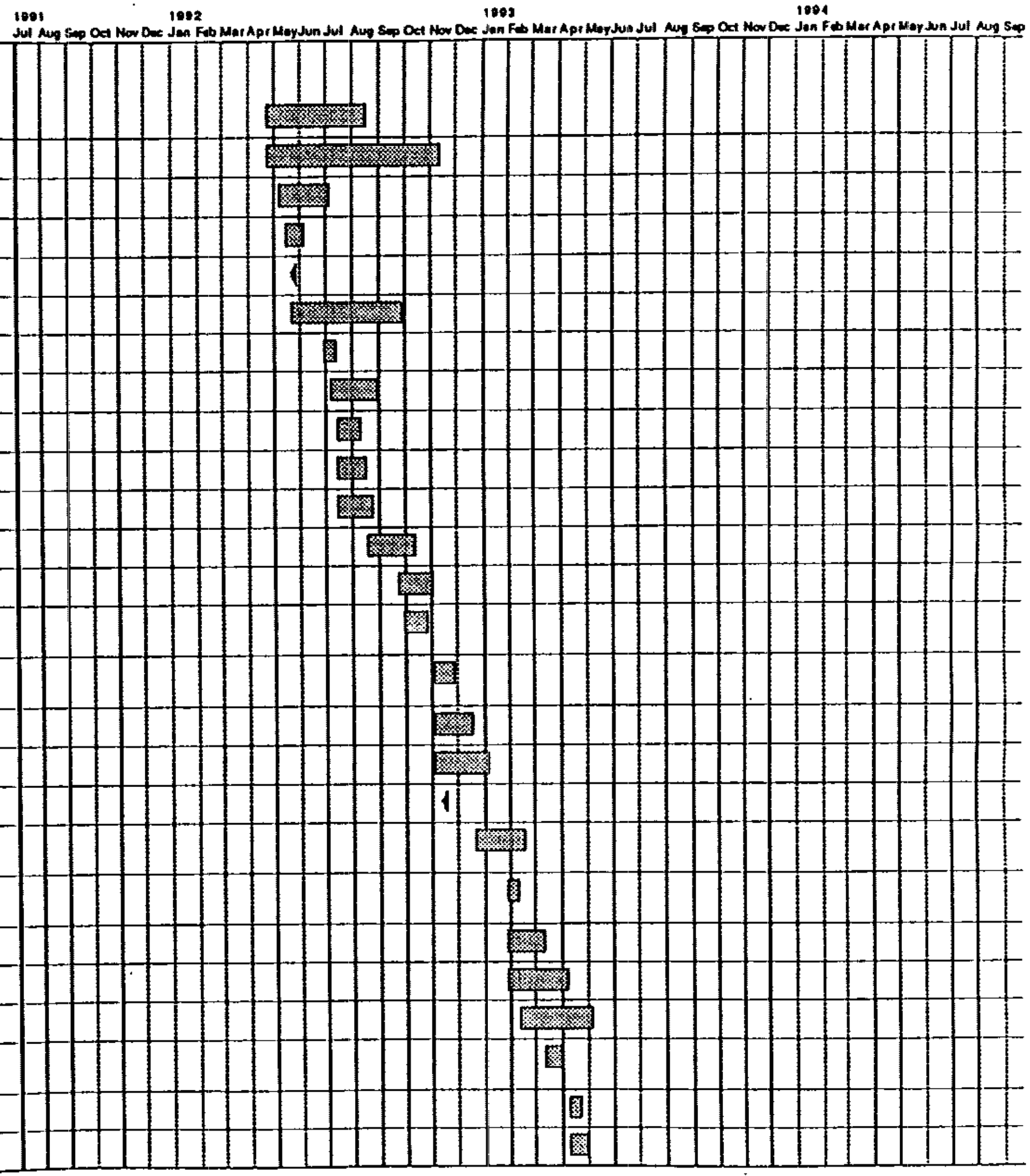

Figure 6-1. (continued)

Date : 19-Oct-91
Time Now : 1-Jul-91
Project : <u>OU 1-07 RI/FS SCHEDULE</u>
Output : Gantt Report
Sheet : 3 of 4

WAG 1

J. R. ZIMMERLE

	Duration	Start	Finish
Legal Review--RI Report/Imp.	3,0	9-Apr-93	28-Apr-93
Draft RI/FS Report/Imp.	9,0	9-Apr-93	11-Jun-93
DOE Review--RI Report/Imp.	4,0	30-Apr-93	28-May-93
Incorporate Comments RI Report/Imp.	2,0	31-May-93	11-Jun-93
Submit Draft RI Report to EPA/IDHW	0,0		11-Jun-93
Tech. Ed/WP--RI/FS Report/Imp.	2,0	14-Jun-93	25-Jun-93
Legal Review--RI/FS Report/Imp.	3,0	14-Jun-93	2-Jul-93
EG&G Review--RI/FS Report/Imp.	3,0	14-Jun-93	2-Jul-93
EPA Review--RI Report/Imp.	6,0	14-Jun-93	26-Jul-93
DOE Review--RI/FS Report/Imp.	5,0	6-Jul-93	9-Aug-93
Prepare Draft Proposed Plan/Imp	13,0	6-Jul-93	5-Oct-93
Incorporate Comments RI/FS Report/Imp	3,0	10-Aug-93	30-Aug-93
Submit Draft RI/FS Report to EPA/IDHW	0,0		30-Aug-93
EPA Review--RI/FS Report/Imp.	6,0	31-Aug-93	12-Oct-93
Prepare Waste ARAR Evaluation Tech Memo	4,0	15-Sep-93	12-Oct-93
Tech Edit/PP/Imp	1,0	6-Oct-93	12-Oct-93
Submit Waste ARAR Evaluation Tech Memo to DOE/EPA/IDHW	0,0		12-Oct-93
EG&G Review PP/Imp	1,0	13-Oct-93	19-Oct-93
Legal Review PP/Imp	1,0	13-Oct-93	19-Oct-93
Revision--RI/FS Report/Imp.	3,0	13-Oct-93	2-Nov-93
DOE Review PP/Imp	4,0	20-Oct-93	17-Nov-93
DOE Review/Imp	1,0	3-Nov-93	10-Nov-93
Finalize RI/FS/Imp	2,0	11-Nov-93	26-Nov-93
Finalize Draft PP/Imp.	3,0	22-Nov-93	10-Dec-93
Submit Final RI/FS/Imp	0,0		26-Nov-93
EPA Approval RI/FS/Imp.	4,0	29-Nov-93	28-Dec-93

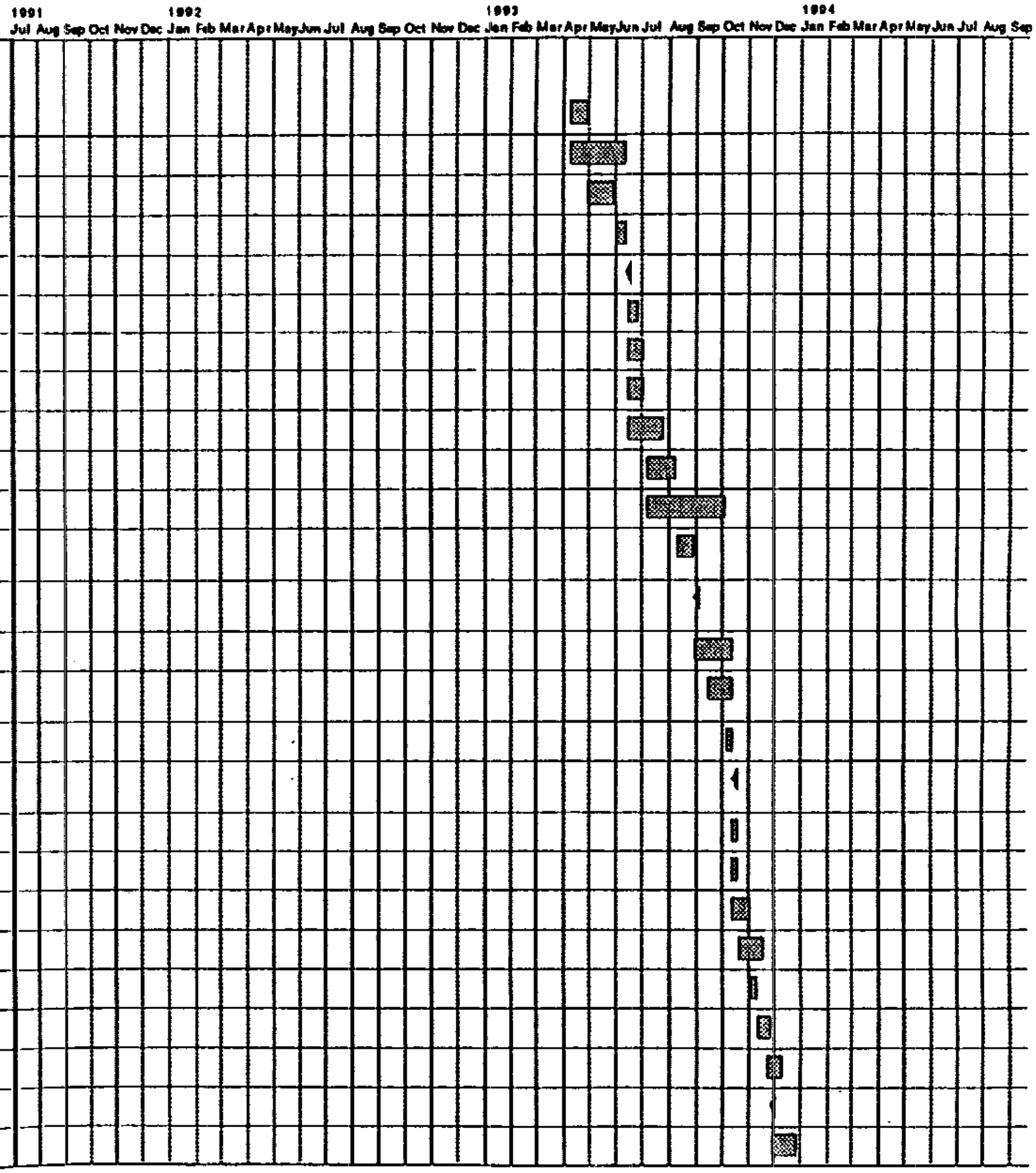

Figure 6-1. (continued)

Date : 18-Oct-91
Time Now : 1-Jul-91
Project : OU 1-07 RI/FS SCHEDULE
Output : Gantt Report
Sheet : 4 of 4

	Duration	Start	Finish
WAG 1			
J. R. ZIMMERLE			
Submit Draft Proposed Plan to DOE/ID-HW	0.0		10-Dec-93
INTERFACE WITH DECISION MAKING FOR WAG 1 OU1-07			13-Dec-93
RI/FS Accepted/Imp	0.0		28-Dec-93

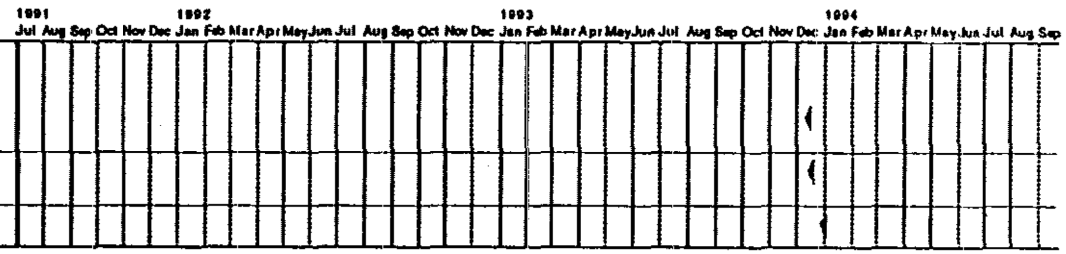

Figure 6-1. (continued)

Date : 19-Oct-91
Time Now : 1-Jul-91
Project : OU 1-07 RI/FS SCHEDULE
Output : Gantt Report
Sheet : 1 of 1

WAG 1

	Duration	Start	Finish
J. R. ZIMMERLE			
Regulatory Review/DM-PP	4,0	13-Dec-93	12-Jan-94
HAMMOCK FOR RI/FS DM OU1-07	39,0	13-Dec-93	20-Sep-94
Incorporate Regul. Comments/DM-PP	2,0	13-Jan-94	26-Jan-94
DOE Review/DM	1,0	27-Jan-94	2-Feb-94
Finalize Plan/DM	1,0	3-Feb-94	9-Feb-94
Pre-Mtg for Public Comment	1,0	3-Feb-94	9-Feb-94
Revised Plan Approved	0,0		9-Feb-94
Public Comment/DM-PP	10,0	10-Feb-94	21-Apr-94
Prepare Draft ROD/DM	8,0	10-Feb-94	5-May-94
Resolve Public Comments/DM	2,0	22-Apr-94	5-May-94
Tech Edit/WP/DM-ROD	1,0	6-May-94	12-May-94
EG&G Review/DM-ROD	1,0	6-May-94	12-May-94
Legal Review/DM- ROD	1,0	6-May-94	12-May-94
DOE Review/DM-ROD	2,0	13-May-94	26-May-94
Finalize Draft ROD/DM	1,0	27-May-94	3-Jun-94
Submit Record of Decision/DM	0,0	3-Jun-94	3-Jun-94
Regulatory Review/DM	6,0	6-Jun-94	18-Jul-94
Incorp. Comments/Submit Draft/DM- ROD	1,0	19-Jul-94	25-Jul-94
Legal Review/DM	1,0	26-Jul-94	1-Aug-94
EG&G Review/DM	1,0	26-Jul-94	1-Aug-94
DOE Review/DM	2,0	2-Aug-94	15-Aug-94
Finalize ROD/DM	1,0	16-Aug-94	22-Aug-94
Final ROD Submitted	0,0		22-Aug-94
EPA Review/DM	4,0	23-Aug-94	20-Sep-94
Final Rod Approved	0,0		20-Sep-94
INTERFACE WITH OU1-10 RI/FS		21-Sep-94	

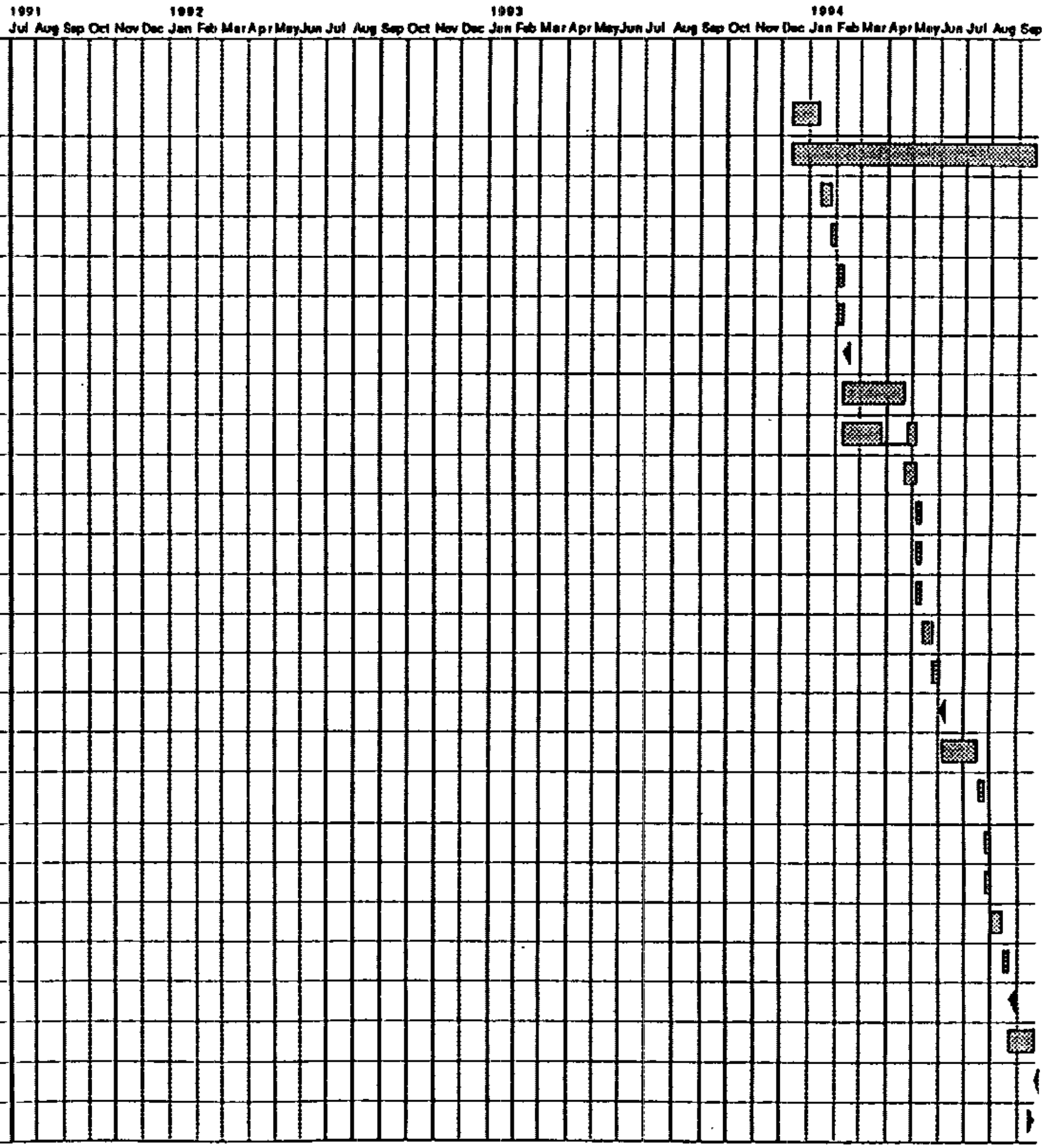

Figure 6-1. (continued)

Table 6-1. Working schedule for the groundwater RI/FS.

Activity	Schedule
1. Draft SOW submitted to EPA/IDHW	July 31, 1991
2. EPA/IDHW review draft SOW	August 1 - September 12, 1991
3. Final Scope of Work submitted to EPA/IDHW	October 16, 1991
4. Draft RI/FS Work Plan submitted to EPA/IDHW	December 31, 1991
5. EPA/IDHW review draft RI/FS Work Plan	January 1, 1992 - February 11, 1992
6. Place scope of work in Administrative Record	January 15, 1992
7. Conduct a workshop to solicit input for evaluating alternatives during public scoping	February 3-5, 1992
8. Scoping meetings	February 3-5, 1992
9. Final RI/FS Work Plan submitted to EPA/IDHW	March 20, 1992
10. Technical memorandum on specific exposure assessment scenario(s) transmitted to EPA/IDHW	June 6, 1992
11. Technical memorandum on preliminary risk assessment transmitted to EPA/IDHW	November 27, 1992
12. Submit draft RI Report to EPA/IDHW	June 11, 1993
13. EPA/IDHW review draft RI report	June 14 - July 26, 1993
14. Draft RI/FS report submitted to EPA/IDHW	August 30, 1993
15. EPA/IDHW review draft RI/FS	August 31 - October 12, 1993
16. Final RI/FS report submitted	November 26, 1993
17. Draft Proposed Plan submitted to EPA/IDHW	December 10, 1993
18. Final RI/FS report accepted	December 28, 1993
19. EPA/IDHW review Proposed Plan	December 13, 1993 - January 12, 1994
20. Revised Proposed Plan submitted for public comment	February 9, 1994

Table 6-1. (continued)

Activity	Schedule
21. Public review of Proposed Plan	February 10 - April 21, 1994
22. Draft ROD and responsiveness summary submitted to EPA/IDHW	June 3, 1994
23. EPA/IDHW review draft ROD and summary	June 6 - July 18, 1994
23. Final ROD submitted	August 28, 1994
24. Final ROD accepted	September 30, 1994

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Number

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